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# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERONAUTICS (GENERAL)

No abstracts in this category.

## 02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

**N76-16014*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**DEPLOY/RELEASE SYSTEM Patent**
David B. Robelen, inventor (to NASA) Issued 6 Jan. 1976 6 p Filed 27 Nov. 1974 Supersedes N75-12195 (13 - 03, p 0287)
(NASA-Case-LAR-11575-1; US-Patent-3,930,628; US-Patent-Appl-SN-527727; US-Patent-Class-244-139) Avail: US Patent Office CSCL 01A

An apparatus is disclosed for arresting uncontrollable motions of model aircraft. A signal is used to deploy a parachute when a model aircraft is in a motion, such as a tailspin, from which the operator cannot recover by manipulating the flight surfaces. After the model aircraft is stabilized to a point where the operator can arrest the uncontrollable motion the parachute is jettisoned and normal flight resumed. The deploy and jettison signals may be sent using a single channel of a multi-channel transmitter and are completely independent of each other.
Official Gazette of the U.S. Patent Office

**N76-16015** Engineering Sciences Data Unit, London (England).
**SECOND-ORDER METHOD FOR ESTIMATING THE SUBCRITICAL PRESSURE DISTRIBUTION ON A TWO-DIMENSIONAL AEROFOIL IN COMPRESSIBLE INVISCID FLOW Transonic Data Memo**
Dec. 1973 20 p
(ESDU-72025) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161 HC $122.50

A method is presented, accurate to second-order in thickness, camber, and incidence, for estimating the subcritical pressure distribution on a two-dimensional aerofoil in compressible inviscid flow. Examples are given of comparisons with a nominally-exact method and it is shown how the method differs from a first-order method used as the basis for the calculation of pressure distributions on finite swept wings and on two-dimensional aerofoils in compressible viscous flow. The second-order method is evaluated indicating that over a wide range of aerofoil shapes, incidence, and Mach number, pressure distributions calculated by the second-order method differ appreciably from nominally-exact calculations only for local regions of aerofoils where high local surface curvature occurs and over the first 20 per cent, of chord for aerofoils having the bluffer leading-edge profiles. Techniques for enumerating the method are outlined and reference is made to a computer program which was used to obtain results from the method.
Author

**N76-16016** Pennsylvania State Univ., University Park.
**RESPONSE OF RECTANGULAR PLATES TO BOUNDARY LAYER TURBULENCE Ph.D. Thesis**
Norman Stuart Lomas 1975 167 p
Avail: Univ. Microfilms Order No. 76-1362

A Green's function solution is presented which was developed for the steady-state vibrations of an elastically-supported rectangular plate with fluid loading. Rotational motion at the plate boundaries was controlled by distributions of rotary springs. The solution was of the form of an infinite series based on the in-vacuo eigenfunctions of a simply-supported rectangular plate. The coefficients were determined from systems of simultaneous algebraic equations that express the coupling due to nonhomogeneous boundary conditions and the presence of the fluid. Results of a numerical evaluation of the modal coupling factors due to fluid loading were compared with the low-frequency approximations. The case of a thin plate excited by a random forcing field is treated and expressions were derived for the power flow in the coupled plate-fluid system. The response of the plate to turbulent boundary-layer excitation was experimentally studied in a water tunnel.
Dissert. Abstr.

**N76-16017** Purdue Univ., Lafayette, Ind.
**AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC FORCE CHARACTERISTICS OF A JET ISSUING TRANSVERSE TO A WEDGE Ph.D. Thesis**
William Lorimer Allan 1968 147 p
Avail: Univ. Microfilms Order No. 76-480

The aerodynamic interaction of a sonic jet issuing from a 15 deg wedge with a transverse supersonic stream produces a side force due to flow interaction in addition to the jet thrust. The magnitude of this interaction force equals or even exceeds the value of the jet thrust. The effect of the flow parameters on the jet interaction is considered based on the inviscid or inertial effects of the interaction of a jet issuing from a flat plate. The results show an abrupt separation ahead of the slot, a short separation region, and a thick boundary layer or wake downstream of the reattachment point. These differences may be all attributed to the higher viscous forces.
Dissert. Abstr.

**N76-16018*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECTS OF FOUR INLET AND OUTLET TIP-ANNULUS-AREA BLOCKAGE CONFIGURATIONS ON THE PERFORMANCE OF AN AXIAL-FLOW FAN ROTOR**
Walter M. Osborn and Roy D. Hager Jan. 1976 29 p refs
(NASA-TN-D-8131; E-8466) Avail: NTIS HC $4.00 CSCL 01A

An axial-flow fan rotor was tested with four configurations of tip-annulus-area blockage to speeds as high as 0.8 of design

speed. The rotor performance with the four blockage configurations is compared with the unblocked rotor performance and with blockage configurations previously investigated. The blockage configurations enable the rotor to operate in a stable condition, to much lower flows than the unblocked rotor, with no evidence of rotating stall. The blockage configurations were effective in reducing rotor torque and weight flow but were accompanied by reductions in pressure ratio and efficiency. Author

**N76-16019#** Advisory Group for Aerospace Research and Development, Paris (France).
**FORCE MEASUREMENTS IN SHORT DURATION HYPERSONIC FACILITIES**
Leonard Bernstein (Queen Mary Coll.) and R. C. Pankhurst, ed. Nov. 1975 224 p refs
(AGARD-AG-214; AGARDograph-214) Avail: NTIS HC $7.75

Attention is drawn to the principle whereby the aerodynamic forces on a model in a wind tunnel are determined by measuring the reactions to them. The discussion is based upon a division of such reactions into two basic classes, depending on the restraints imposed. Where no restraints exist, the model flies freely and the forces may be inferred from the accelerations, either measured directly or derived from displacement vs. time data. When the model is supported, the forces are determined from measurements of the mechanical strains induced in suitably designed supports. Hybrid techniques, where these extreme cases of no restraint or nearly complete restraint cannot be assumed, are also discussed. A detailed discussion of transducer sensing elements and their incorporation into measuring systems is given. Some particular systems are also described. For individual titles, see N76-16020 through N76-16022.

**N76-16020** Advisory Group for Aerospace Research and Development, Paris (France).
**SOME FUNDAMENTAL PRINCIPLES**
*In its* Force Meas. in Short Duration Hypersonic Facilities Nov. 1975 p 7-50 (For availability see N76-16019 07-02)

The motion produced by the action of forces on a system is described by the equations of motion for the system; these equations are formulated using the Newtonian and Lagrangian approaches. Topics discussed include aerodynamic data from the analysis of unrestrained motion, aerodynamic data from measurements of the reaction in supports, hybrid techniques, aerodynamic characteristics, aerodynamic forces and moments, and degrees of freedom. M.J.S.

**N76-16021** Advisory Group for Aerospace Research and Development, Paris (France).
**FORCE BALANCE TECHNIQUES**
*In its* Force Meas. in Short Duration Hypersonic Facilities Nov. 1975 p 52-104 (For availability see N76-16019 07-02)

The design of a force balance for transient measurements takes into account both its static and its dynamic performance. The properties are reviewed of those solid state materials which are usefql as electromechanical transducers in force balances having a sufficiently good high-frequency performance of use in short duration hypersonic wind tunnels. Other topics discussed include general aspects of force-balance design, electrical systems for signal generation and processing, data recording, and calibration techniques. M.J.S.

**N76-16022** Advisory Group for Aerospace Research and Development, Paris (France).
**FREE/FLIGHT TECHNIQUES**
*In its* Force Meas. in Short Duration Hypersonic Facilities Nov. 1975 p 104-214 refs (For availability see N76-16019 07-02)

Methods are discussed for acquiring force data based on studies of the motion of models 'flying' under laboratory conditions. The model presented is potentially free of all extraneous influences from supports, and premature boundary layer separation and inaccurate representation of the base region are avoided in addition to those problems arising from vibration of the supports. The design and manufacture of models, model suspension, launching and capture systems, position and attitude as a function of time, velocity measurements, and acceleration measurements are also discussed. M.J.S.

**N76-16023*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**NUMERICAL STUDIES OF INCOMPRESSIBLE VISCOUS FLOW IN A DRIVEN CAVITY**
Washington 1975 132 p refs
(NASA-SP-378) Avail: NTIS HC $6.00 CSCL 20D

A series of project papers is presented in computational fluid dynamics. The work was performed during the 1973-74 academic year at Old Dominion University. Each paper briefly examines a numerical method(s) that can be applied to the Navier-Stokes equations governing incompressible flow in a driven cavity. Solutions obtained with a cubic spline procedure are also included. For individual titles, see N76-16024 through N76-16032.

**N76-16024*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**INCOMPRESSIBLE VISCOUS FLOW IN A DRIVEN CAVITY**
Stanley G. Rubin and Julius E. Harris *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 1-6 refs (For availability see N76-16023 07-02)
CSCL 20D

The flow of an incompressible viscous fluid in a cavity driven by a uniformly moving boundary exhibits a number of complex fluid dynamic characteristics of interest including vortex development and boundary-layer development on the walls of the cavity (for high Reynolds numbers). An incompressible viscous flow in a cavity driven by a uniformly moving upper surface was predicted by several numerical techniques. Solutions were obtained for the Navier-Stokes and continuity equations written in either primitive or vorticity--stream-function variables. Results are presented and discussed. Author

**N76-16025*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**APPLICATION OF UPSTREAM WEIGHTED DIFFERENCING TO THE DRIVEN CAVITY PROBLEM**
Lillian R. Boney *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 7-22 refs (For availability see N76-16023 07-02)
CSCL 20D

A steady plane flow was calculated of an incompressible viscous fluid in a two-dimensional square cavity in which the motion was driven by uniform translation of the upper wall which moved across the cavity from left to right at a constant speed of 1. Numerical solutions of the Navier-Stokes equations were obtained for a range of Reynolds numbers from 100 to 1000. Upstream weighted differencing was used when the local cell Reynolds number exceeded 2. Tables (data) of flow velocity are given and results are presented and discussed. Author

**N76-16026*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SOLUTION OF THE INCOMPRESSIBLE DRIVEN CAVITY PROBLEM USING THE CROCCO METHOD**
Jerry N. Hefner *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 23-32 refs (For availability see N76-16023 07-02)
CSCL 20D

The Crocco method was used to solve the steady Navier-Stokes equations for two-dimensional flow in a square driven cavity for a Reynolds number of 100. Results for velocity and pressure are found to be inaccurate, although the overall recirculation and vortex center are correctly predicted. Tables (data) of velocity profiles and pressure distributions are given. Author

**N76-16027*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SOLUTION OF THE DRIVEN CAVITY PROBLEM IN PRIMITIVE VARIABLES USING THE SMAC METHOD**
Richard S. Hirsh *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 33-46 refs (For availability see N76-16023 07-02)
CSCL 20D

The equations of two-dimensional incompressible fluid flow in a square driven cavity were solved in terms of primitive variables and stream functions. A Simplified Marker-and-Cell method was

used with forward time and centered space (FTCS) differencing and with modified forward time and centered space (MFTCS) differencing. The problem could not be solved for a Reynolds number of 100 with FTCS differencing because of stability limitations. For a Reynolds number of 10, the results are found to be inaccurate because of the inability of the pressure solver to converge to small tolerances. The MFTCS differencing seemed to relax the stability restriction on time step, but the limit on cell Reynolds number was retained. A lower order boundary condition on pressure resulted in marginal improvement. Tables (data) of flow velocities are included. Author

**N76-16028*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SOLUTION OF THE INCOMPRESSIBLE DRIVEN CAVITY PROBLEM BY THE ALTERNATING-DIRECTION IMPLICIT METHOD**
Dana J. Morris *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 47-59 refs (For availability see N76-16023 07-02)
CSCL 20D

A second-order accurate alternating-direction implicit (ADI) method was used to solve the two-dimensional incompressible Navier-Stokes equations for flow in a square driven cavity. Calculations were made at a Reynolds number of 100 with equally spaced 15 by 15, 17 by 17, 33 by 33, and 57 by 57 grids and at a Reynolds number of 10 with a 15 by 15 grid. The ADI results agree well with other solutions. Choosing a criterion for convergence which was too strict was found to result in no steady-state solution being reached. A study of the maximum allowable time step for a Reynolds number of 100 indicated that time steps many times larger than those used for most consistent explicit methods could be used for the ADI method. Tables (data) of flow velocity and stream functions are given. Author

**N76-16029*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**COMPARATIVE STUDY OF TWO NUMERICAL TECHNIQUES FOR THE SOLUTION OF VISCOUS FLOW IN A DRIVEN CAVITY**
Robert E. Smith, Jr. and Amy Kidd (Computer Sciences Corp., Hampton, Va.) *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 61-82 refs (For availability see N76-16023 07-02)
CSCL 20D

Numerical solutions were obtained for the steady two-dimensional flow of a viscous incompressible fluid in a rectangular cavity. The Reynolds number was varied from 100 to 5000. The conservative stream-function--vorticity form of the two-dimensional incompressible Navier-Stokes equations was solved. Two techniques (alternating-direction implicit and hopscotch) were applied to the vorticity equation. The stream-function equation was solved by successive overrelaxation and by the Buneman direct method. The investigation assessed which combination of these techniques, applied to the stream-function--vorticity form of the Navier-Stokes equations, is the most computationally efficient. Width-depth ratios of 1, 2, and 4 were used in this numerical experiment. Relative efficiency was based on the central processing time of each technique run on the same computer. The results indicate that the alternating-direction implicit technique for solving the vorticity equation and the Buneman direct method for solving the stream-function equation yield the most efficient combination of the techniques studied. Contour plots are shown. Author

**N76-16030*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**CALCULATION OF STEADY VISCOUS FLOW IN A SQUARE DRIVEN CAVITY BY THE ARTIFICIAL COMPRESSIBILITY METHOD**
John T. Suttles *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 83-102 refs (For availability see N76-16023 07-02)
CSCL 01A

Numerical solutions of steady viscous flow in a two-dimensional cavity have been obtained by the method of artificial compressibility. The method was programmed for a computer solution and checked against a simple channel flow problem which has an analytical solution. The comparison indicated that the method was correctly programmed. Results for a square cavity at a Reynolds number of 100 were then obtained and compared with published results. This comparison shows that the method produces good results for velocities but that the computed pressures are unreliable. Author

**N76-16031*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**FINITE-DIFFERENCE SOLUTION FOR THE INCOMPRESSIBLE DRIVEN CAVITY FLOW PROBLEM**
Ernest V. Zoby *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 103-118 refs (For availability see N76-16023 07-02)
CSCL 20D

An alternating-direction implicit (ADI) finite-difference procedure for Navier-Stokes equations was employed to compute the two-dimensional viscous incompressible flow generated within a rectangular cavity by a moving surface at the cavity open end. The pressure through the cavity was computed by the Spalding method. The Spalding method relates a perturbation in pressure at each time step to the continuity relation so that at steady state the pressure at each node point is determined and the continuity equation is satisfied. Although the ADI method does not predict axial and normal velocities as high as indicated by more exact methods, the values of the velocities through the vortex center are reasonably predicted and the overall velocity vector diagrams appear satisfactory. The pressure levels are generally in poor agreement with other predictions. However, the pressure gradients must be reasonably well predicted because of the accurate results obtained for the velocities. Flow velocity diagrams are shown. Author

**N76-16032*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**CUBIC SPLINE SOLUTION FOR THE DRIVEN CAVITY**
Stanley G. Rubin and Randolph A. Graves, Jr. *In its* Numerical Studies of Incompressible Viscous Flow in a Driven Cavity 1975 p 119-132 refs (For availability see N76-16023 07-02)
CSCL 20D

A cubic spline procedure for solution of the vorticity--stream-function system for flow in a driven cavity is described. The spline results were compared with finite-difference results and were found to be more accurate, even near the boundaries. A nonuniform grid was also used with increased mesh density in regions where diffusion was important. Considerable advantages of the spline procedure with a nonuniform grid were indicated in regions of large gradients. Tables (data) are given which show grid size, vorticity, and stream functions. Author

**N76-16033*#** Chrysler Corp., New Orleans, La. Space Div.
**AERODYNAMIC RESULTS OF A SEPARATION TEST (CA20) CONDUCTED AT THE BOEING TRANSONIC WIND TUNNEL USING 0.030-SCALE MODELS OF THE CONFIGURATION 140A/B (MODIFIED) SSV ORBITER (MODEL NO. 45-0) AND THE BOEING 747 CARRIER (MODEL NO. AX 1319 I-1), VOLUME 1**
T. Dziubala (Rockwell Intern., Downey, Calif.), V. Esparza (Rockwell Intern., Downey, Calif.), R. L. Gillins (Rockwell Intern., Downey Calif.), and M. Petrozzi (Rockwell Intern., Downey, Calif.) Dec. 1975 921 p refs
(Contract NAS9-13247)
(NASA-CR-141844; DMS-DR-2217-Vol-1) Avail: NTIS HC $23.75 CSCL 01A

A Rockwell built 0.030-scale 45-0 modified Space Shuttle Orbiter Configuration 14A/B model and a Boeing built 0.030-scale 747 carrier model were tested to provide six component force and moment data for each vehicle in proximity to the other at a matrix of relative positions, attitudes and test conditions (angles of attack and sideslip were varied). Orbiter model support system tare effects were determined for corrections to obtain support-free aerodynamics. In addition to the balance force data, pressures were measured. Pressure orifices were located at the base of the Orbiter, on either side of the vertical blade strut, and at the mid-root chord on either side of the vertical tail. Strain gages were installed on the Boeing 747 vertical tail to indicate buffet

onset. Photographs of aerodynamic configurations tested are shown. Author

**N76-16034*#** Chrysler Corp., New Orleans, La. Space Div.
**AERODYNAMIC RESULTS OF A SEPARATION TEST (CA20) CONDUCTED AT THE BOEING TRANSONIC WIND TUNNEL USING 0.030-SCALE MODELS OF THE CONFIGURATION 140A/B (MODIFIED) SSV ORBITER (MODEL NO. 45-0) AND THE BOEING 747 CARRIER (MODEL NO. AX 1319 I-1), VOLUME 2**
T. Dziubala (Rockwell Intern., Downey, Calif.), V. Esparza (Rockwell Intern., Downey, Calif.), R. L. Gillins (Rockwell Intern., Downey, Calif.), and M. Petrozzi (Rockwell Intern., Downey, Calif.) Dec. 1975 1021 p refs
(Contract NAS9-13247)
(NASA-CR-141845; DMS-DR-2217-Vol-2) Avail: NTIS HC $28.25 CSCL 01A
For abstract, see N76-16033.

**N76-16035*#** Chrysler Corp., New Orleans, La. Space Div.
**AERODYNAMIC RESULTS OF A SEPARATION TEST (CA20) CONDUCTED AT THE BOEING TRANSONIC WIND TUNNEL USING 0.030-SCALE MODELS OF THE CONFIGURATION 140A/B (MODIFIED) SSV ORBITER (MODEL NO. 45-0) AND THE BOEING 747 CARRIER (MODEL NO. AX 1319 I-1), VOLUME 3**
T. Dziubala (Rockwell Intern., Downey, Calif.), V. Esparza (Rockwell Intern., Downey, Calif.), R. L. Gillins (Rockwell Intern., Downey, Calif.), and M. Petrozzi (Rockwell Intern., Downey, Calif.) Dec. 1975 1106 p refs
(Contract NAS9-13247)
(NASA-CR-141846; DMS-DR-2217-Vol-3) Avail: NTIS HC $32.75 CSCL 01A
For abstract, see N76-16033.

**N76-16036*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Aerospace and Ocean Engineering Dept.
**AN INVESTIGATION OF SUPERSONIC AEROELASTIC CHARACTERISTICS OF OBLIQUE WINGED AIRCRAFT**
**Semiannual Progress Report, 1 Apr. - 30 Sep. 1975**
Terry A. Weisshaar 30 Sep. 1975 38 p refs
(Grant NsG-2016)
(NASA-CR-146141) Avail: NTIS HC $4.00 CSCL 01A
Two formulations of the oblique wing flutter problem are presented: one formulation allows wing bending deformations and the rigid body roll degree of freedom while the second formulation includes bending-torsional deformation and roll degrees of freedom. Flutter is found to occur in two basic modes. The first mode is associated with bending-roll coupling and occurs at low reduced frequency values. The other instability mode is primarily one of classical bending-torsion with negligible roll coupling; this mode occurs at much higher reduced frequencies. The occurrence of bending-roll coupling mode leads to lower flutter speeds while the bending-torsion mode is associated with higher flutter speeds. The ratio of the wing mass moment of inertial in roll to the fuselage moment of inertia evidently plays a major role in the determination of which of the two instabilities is critical. Author

**N76-16037*#** New York Univ., Westbury. Aerospace and Energetics Lab.
**SKIN FRICTION REDUCTION BY SLOT INJECTION AT MACH 0.8 Final Report, 1 Apr. 1974 - 31 Jul. 1975**
Victor Zakkay and Chi R. Wang 31 Jul. 1975 85 p refs
(Grant NsG-1049)
(NASA-CR-146355) Avail: NTIS HC $5.00 CSCL 01A
Surface skin friction, boundary layer profiles and turbulent intensity due to axially symmetric tangential slot injection into a transonic turbulent boundary layer were measured for a blowdown wind tunnel. Effects of slot height, multiple slot injection, and injection mass flow rate on the surface skin friction downstream of the slot were investigated. Large normal pressure gradient and relatively large turbulent intensity were found near the slot with small injection mass flow rate; the region of high turbulent intensity moved downstream with increasing injection mass flow rate. The results with two slot injection indicate that the distance between slots should be less than 30 slot heights in order to achieve some benefits from the first slot. Of significant importance in the investigation is that the skin friction reduction obtained at transonic speed is of the same order as obtained in the hypersonic regime. Schematic diagrams of test setup are shown. Author

**N76-16038*#** Boeing Vertol Co., Philadelphia, Pa.
**VIBRATORY HUB LOAD DATA REDUCTION AND ANALYSIS FROM THE REVERSE VELOCITY ROTOR WIND TUNNEL TEST, PHASE 2B**
R. B. Taylor Jan. 1976 163 p refs
(Contract NAS2-8630)
(NASA-CR-137780; D210-11004-1) Avail: NTIS HC $6.75 CSCL 01A
The vibratory hub loads data analysis from the reverse velocity rotor wind tunnel test is reported. Vibratory loads were obtained from the rotating hub balance and also by synthesis of generalized coordinates from the blade flap bending moments. Load trends were defined as a function of speed, rotor thrust and 2 per rev cyclic from each of the data methods. These trends were compared to determine the degree of agreement between each method and provide substantiation for the generalized coordinate approach. Author

**N76-16039#** Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
**HEAT TRANSFER MEASUREMENTS ON A DELTA WING WITH BLUNTED LEADING EDGES IN HYPERSONIC FLOW**
Bo Lemcke Mar. 1975 39 p refs
(Contract FMV-INK-11-12-73292)
(FFA-TN-AU-648-Pt-3) Avail: NTIS HC $4.00
To study the influence of leading edge blunters on heat transfer rates, pressure distribution and heat transfer measurements were made on a model of a delta wing with blunted leading edges in a hypersonic wind tunnel. The model was later tested in a free flight experiment at a range in Woomera, Australia. In the wind tunnel tests the effects of small angles of incidence and yaw were investigated. Only small, but still noticeable variations in pressure and heat transfer rates were observed. The performed measurements of pression and heat transfer distributions on the delta wing together with schlieren and oil dot pictures gave no conclusive results in terms of the flow around the model and the presence of transition to turbulent boundary layer. Some modifications in the data processing system and the measurement stations are suggested. Author (ESA)

**N76-16040#** Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
**CALCULATIONS OF TWO-DIMENSIONAL POTENTIAL FLOW WALL INTERFERENCE FOR MULTI-COMPONENT AIRFOILS IN CLOSED LOW SPEED WIND TUNNELS**
Lars-Erik Eriksson Apr. 1975 50 p refs
(Contract F-INK-82223-73-009-07001)
(FFA-TN-AU-1116-Pt-1) Avail: NTIS HC $4.00
The two-dimensional optimization of high lift devices requires the use of large models to obtain reliable results. The accommodation of these models in given wind tunnels necessitates advanced interference calculations, since classical wall correction methods are unsatisfactory. For attached flow it is thought that the total interference can be separated into a viscid wake blockage part and an inviscid potential flow part. A numerical method calculating the potential flow part was developed and tested. The airfoil and tunnel boundaries were simulated by a continuous surface vortex distribution, determined by the boundary conditions. The results for a simple airfoil between tunnel walls agree well with analytic methods where these apply. Analogous results for a wing-flap configuration show that the lift interference is nonlinear in lift coefficient. This effect is caused by the large vertical displacement of the flap. Author (ESA)

**N76-16041#** National Aerospace Lab., Amsterdam (Netherlands).
**AN INTRODUCTORY DESCRIPTION OF A HODOGRAPH METHOD FOR TRANSONIC SHOCK-FREE AEROFOIL DESIGN**
J. W. Boerstoel and G. H. Huizing 15 Nov. 1973 43 p refs
(NLR-TR-73152-U) Avail: NTIS HC $4.00
The aerodynamic design process for transonic shock-free airfoils using the analytical hodograph theory is sketched. A

user-oriented outline of the developed program system is presented. A number of examples of computed airfoils show that the computer program package provides final results of sufficient accuracy at acceptable costs and seems flexible enough to cover a wide range of engineering applications. ESA

**N76-16042#** National Aerospace Lab., Amsterdam (Netherlands). Div. Scientific Services.

**DIFFERENCES IN INVISCID ISENTROPIC MODELS USED FOR FINITE DIFFERENCE CALCULATION OF TRANSONIC FLOW WITH SHOCKS ABOUT AIRFOILS: THE PREDICTION OF WAVE DRAG**

J. VanderVooren and J. W. Slooff 14 Jan. 1974 43 p refs Sponsored by Neth. Agency for Aerospace Programs (NIVR)
(NLR-TR-74002-U) Avail: NTIS HC $4.00

Properties of inviscid isentropic flow models underlying finite difference methods for the calculation of two-dimensional transonic flows with embedded shocks about airfoils are discussed and compared. Attention is drawn to the fact that the isentropic time-dependent model and the isentropic model used in relaxation-type methods are fundamentally different. It was pointed out that the two models each imply a different wave drag mechanism. From a comparison of the shock-jump relations of the different isentropic model with the Rankine-Hugoniot jump relations and a semi-quantitative analysis of wave drag, it is concluded that the isentropic time-dependent model provides the best approximation to non-isentropic Rankine-Hugoniot flow. In calculations of steady flow, however, the use of this model has no real advantage over using non-isentropic Rankine-Hugoniot flow as a model. Author (ESA)

**N76-16043#** National Aerospace Lab., Amsterdam (Netherlands).

**A MODEL FOR THE CALCULATION OF THE PROPERTIES OF A JET IN A CROSS FLOW**

H. Snel 5 Jun. 1974 56 p refs
(Contract NIVR-RB-1736)
(NLR-TR-74080-U) Avail: NTIS HC $4.50

A semi-empirical model was derived for the calculation of the properties of a jet exhausting into a cross flow, at an arbitrary initial angle. The main empirical input is the velocity decay along the jet axis, derived from available measurements. The model is a generalization of an earlier model for a jet exhausting perpendicular into a cross flow. The following jet properties can be calculated: the jet trajectory, the length of the potential core region, the jet mass flux (entrainment), and the cross sectional area. Comparison with measurements shows resonable agreement. Author (ESA)

**N76-16044#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

**ON THE DETERMINATION OF BODY-WING INTERFERENCE IN THE NONLINEAR ANGLE OF ATTACK RANGE [ZUR BESTIMMUNG DER FLUEGEL-RUMPFINTERFERENZ IM NICHTLINEAREN ANSTELLWINKELBEREICH]**

Gregor Gregoriou Bonn DOKZENTBw 1975 28 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(BMVg-FBWT-75-2) Avail: NTIS HC $4.00; DOKZENTBw DM 20

Based on a potential theory an iterative singularity method was developed for determining the pressure distribution of symmetric body-wing configurations in the non-linear angle of attack range. The body is axisymmetric, of finite length, and of arbitrary thickness. The wing is infinitely thin and located at mid-wing position. A comparison with wind-tunnel tests confirms that the proposed mathematical model is adequate, but the numerical procedure has to be improved. Author (ESA)

**N76-16045#** Technische Hogeschool, Delft (Netherlands). Dept. of Aeronautical Engineering.

**CALCULATION METHODS FOR THE SUPERSONIC FLOW FIELD OF AN ARROWED WING WITH SUBSONIC LEADING EDGE WITH PART OF THE FLOW PLANE AS FUSELAGE [BEREKENINGSMETHODEN VOOR HET SUPERSONE STROMINGSVELD VAN EEN PIJLVLEUGEL MET SUBSONE VOORRAND MET EEN DEELSTROOMVLAK ALS ROMP]**

J. M. deKooter Mar. 1975 82 p refs In DUTCH Sponsored by Neth. Organ. for Pure Sci. Res. (ZWO)
(VTH-195) Avail: NTIS HC $5.00

Assuming the fuselage is part of the flow plane of an oblique wing under supersonic conditions the flow fields were calculated. At subsonic leading edge conditions this flow is shock free. The supersonic flow around an infinite oblique wing is discussed and the geometry of the partial flow planes of the fuselage are dealt with. The two-dimensional flow field was calculated, followed by a discussion of the three-dimensional flow. Finally the shock strength in the far field was calculated. An asymptotic treatment of the flow around an oblique wing is annexed. ESA

**N76-16046#** Bristol Univ. (England). Dept. of Aeronautical Engineering.

**THE OUT-OF-PLANE FORCE ON AN OGIVE NOSED CYLINDER AT LARGE ANGLES OF INCLINATION TO A UNIFORM STREAM Ph.D. Thesis**

P. J. Lamont Sep. 1973 303 p refs Sponsored in part by Sci. Res. Council and BAC
Avail: NTIS HC $9.75

Out-of-plane forces and moments which act on cylindrical bodies fitted with tapered noses at large angles of inclination to a uniform subsonic stream were investigated. The existence of these forces and moments is explained qualitatively on the basis of an impulsively-started cross flow analogy. This model being unsuited to good quantitative predictions, an experimental investigation was made to determine the distribution of out-of-plane force along a cylindrical body, fitted with various nose shapes, over the inclination range from 0 to 90 deg. Results show an oscillatory distribution. Empirical approximations were made to the variations of the amplitude and spacing of the force distribution with inclination and nose fineness ratio. These were incorporated with a prediction method which can calculate the out-of-plane force and moment on an ogive/cylinder over the inclination range from 0 to 90 deg in laminar flow conditions. ESA

**N76-16047#** European Space Agency, Paris (France).

**CALCULATION OF THE INVISCID FLOW FIELD AROUND THREE-DIMENSIONAL LIFTING WINGS, FUSELAGES AND WING-FUSELAGE COMBINATIONS USING THE PANEL METHOD**

Syed Rafeeq Ahmed Dec. 1975 67 p refs Transl. into ENGLISH of "Berechnung des reibungslosen Stroemungsfeldes von dreidimensionalen auftriebsbehafteten Tragfluegeln, Ruempfen u. Fluegel-Rumpf-Kombinationen nach dem Panel-Verfahren", DFVLR, Brunswick Report DLR-FB-73-102, 21 Aug. 1973 Original German report available from DFVLR, Porz, West Ger. 16 DM
(ESA-TT-210; DLR-FB-73-102) Avail: NTIS HC $4.50

The practical use of the panel method for calculating the inviscid flow field around arbitrarily shaped wings, fuselages, and wing-fuselage combinations was verified on the basis of four examples: swept wing and three wing-body configurations. A modified version of a computer program developed at Messerschmitt-Boelkow-Blohm in Munich was used for this investigation. Th3 investigations included the prediction of the pressure field over the complete wing and body surfaces of the configurations. The results of the calculation were compared with corresponding measurements. Author (ESA)

**N76-16048#** Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

**THE MEASUREMENT OF AERODYNAMIC FORCES ON A SHORT BODY AT HIGH ANGLES OF ATTACK WITH THE MAGNETIC BALANCE SYSTEM Final Report, 31 Mar. - 31 Dec. 1974**

R. L. Bisplinghoff, J. B. Coffin, E. E. Covert, D. M. Finn, and C. W. Maldeman Dover, N. J. Picatinny Arsenal Dec. 1974 68 p refs
(Contract DAAA21-74-C-0304)
(AD-A012071; TR-190; PA-TR-4806) Avail: NTIS CSCL 20/4

Aerodynamic lift coefficient, drag coefficient and pitching moment coefficient are reported for a short finned body at angles of attack from -20 to +20 degrees as measured with the magnetic balance system at M=.18 and .37, Re sub d=100,000 and 200,000. Also reported are modifications made to the magnetic balance system in order to extend the angle of attack range. A

new controllable D. C. power supply was constructed using 300 ampere, 30 volt D. C. aircraft generators. The steady state and transient response characteristics of this power supply are reported. Author (GRA)

**N76-16049#** Army Missile Command, Redstone Arsenal, Ala.
**A METHODOLOGY FOR DETERMINING THE FLIGHT PATH OF A SIX DEGREE OF FREEDOM AIRCRAFT AND ITS ORIENTATION WITH RESPECT TO A GROUND SITE**
Harold R. Bright and John M. Whitaker Jul. 1975 37 p refs
(AD-A015011; USAMICON-C-TR-75-11) Avail: NTIS CSCL 01/2

This report presents a unique methodology for determining maneuvers of a six degree of freedom target whose flight path has been prescribed by a set of straight line segments. The attitude of this target at any point in time with respect to a ground site is also determined. The methodology can be applied to the modeling of any system whose performance is related to the orientation of the target with respect to a ground site. GRA

**N76-16050#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**A METHOD FOR THE CALCULATION OF PARACHUTE OPENING FORCES FOR HIGH ALTITUDE BALLOON PAYLOADS Instrumentation Papers**
Peter L. Miller, Jr. 7 May 1975 21 p refs
(AF Proj. 6665)
(AD-A014805; AFCRL-TR-75-0260; AFCRL-IP-233) Avail: NTIS CSCL 01/3

One of the questions most frequently asked by scientists/experimenters who design balloon payloads concerns the magnitude of the opening forces of the parachute recovery system. Existing theory and an analytical method recently developed for horizontal deployment are adapted to balloon systems requirements. Engineering methods are used to develop expressions which allow the assessment of the parachute opening forces. GRA

# 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

**N76-16051*#** Stanford Research Inst., Menlo Park, Calif.
**AN ANALYSIS OF AIRCRAFT ACCIDENTS INVOLVING FIRES Technical Report, 22 Oct. 1974 - 22 May 1975**
G. V. Lucha, M. A. Robertson, and F. A. Schooley May 1975 148 p refs
(Contract NAS2-8535)
(NASA-CR-137690) Avail: NTIS HC $6.00 CSCL 01C

All U. S. Air Carrier accidents between 1963 and 1974 were studied to assess the extent of total personnel and aircraft damage which occurred in accidents and in accidents involving fire. Published accident reports and NTSB investigators' factual backup files were the primary sources of data. Although it was frequently not possible to assess the relative extent of fire-caused damage versus impact damage using the available data, the study established upper and lower bounds for deaths and damage due specifically to fire. In 12 years there were 122 accidents which involved airframe fires. Eighty-seven percent of the fires occurred after impact, and fuel leakage from ruptured tanks or severed lines was the most frequently cited cause. A cost analysis was performed for 300 serious accidents, including 92 serious accidents which involved fire. Personal injury costs were outside the scope of the cost analysis, but data on personnel injury judgements as well as settlements received from the CAB are invluded for reference. Author

**N76-16052*#** Duke Univ., Durham, N.C. Dept. of Civil Engineering.
**THE ROLE OF THE HELICOPTER IN TRANSPORTATION**
Jarir S. Dajani, Dennis Warner, David Epstein, and Jeremy OBrien 13 Feb. 1976 75 p refs
(Grant NsG-1121)
(NASA-CR-146351) Avail: NTIS HC $4.50 CSCL 01C

A general overview is presented of the role that the helicopter plays in the current aviation scene with special emphasis on its use in the airport access function. Technological problems of present-day aircraft are discussed along with some plausible solutions. The economic and regulatory aspects of commercial helicopter operations are presented. Finally six commercial operations utilizing helicopters are reviewed and conditions that enhance the success of the helicopter in the airport access function are proposed. Author

**N76-16053#** Committee on Government Operations (U. S. House).
**IMPROVED PROCEDURES NEEDED BY FAA FOR IMPLEMENTING NTSB SAFETY RECOMMENDATIONS**
Washington GPO 1975 73 p refs Hearing before a subcomm. of Comm on Govt. Operations, 94th Congr., 1st. Sess., 25 Mar. 1975
(GPO-50-870) Avail: Comm. on Govt. Operations.

The Federal Aviation Administration (FAA) system for responding to and implementing the National Transportation Safety Board's recommendations following an aircraft accident investigation is examined along with the Board's system for monitoring and following up on FAA's responses. J.M.S.

**N76-16054#** Loughborough Univ. of Technology (England). Dept. of Transport Technology.
**SURVEY ANALYSIS OF AIRPORT TERMINAL PASSENGER PROCESSING**
D. Bennetts, N. M. Hawkins, P. D. McGinity, M. OLeary, and N. Ashford Apr. 1975 78 p refs Sponsored by Sci. Res. Council
(TT-7502) Avail: NTIS HC $5.00

A survey of the passenger processing system at Manchester International Airport is described in order to demonstrate the relevance to terminal planning and design of obtaining information on passenger behavior. The survey examined the way in which passengers organize their time in the terminal in terms of both processing, circulation, and waiting times. The examination of passenger behavior in terminals has highlighted three main areas of concern for future research namely passenger attitudes, ancillary facilities, and access to the terminal. Author (ESA)

**N76-16055#** Naval Surface Weapons Center, White Oak, Md.
**AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS. BASIC RELATIONSHIPS IN MILITARY FIRES, PHASE 4; HIGH SPEED DISSEMINATION OF DRY CHEMICAL FIRE SUPPRESSION AGENTS Final Technical Report, Mar. - Nov. 1974**
R. S. Alger, F. I. Laughridge, L. L. Wiltshire, R. G. McKee, and W. H. Johnson Wright-Patterson AFB, Ohio DOD Aircraft Ground Fire Suppression and Rescue Office May 1975 63 p refs Prepared jointly by Stanford Res. Inst., Menlo Park, Calif.
(AD-A014227; DOD-AGFSRS-75-3) Avail: NTIS CSCL 13/2

The feasibility and effects of applying dry chemical fire suppression agents at very high rates were explored with a series of cascade and pool type jet-fuel fires. Powders were dispensed at conventional rates with hand held extinguishers and at high rates with a rocket motor type disseminator. Typical discharge conditions with the high speed disseminator are described, along with fire sizes and effectiveness. GRA

**N76-16056#** Naval Surface Weapons Center, White Oak, Md.
**AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS. BASIC RELATIONSHIPS IN MILITARY FIRES. PHASES 3, 5, 6, AND 7 Final Technical Report, Oct. 1971 - Nov. 1974**
R. S. Alger and Ervin L. Capner Wright-Patterson AFB, Ohio DOD Aircraft Ground Fire Suppression and Rescue Office May 1975 158 p refs Prepared jointly by Stanford Res. Inst., Menlo Park, Calif.
(AD-A014228; DOD-AGFSRS-75-4) Avail: NTIS CSCL 13/12

The suppression of class B fuel fires with aqueous film forming foam was studied as a function of fuel, environment, and mode of agent application. Cooling, insulating, and isolating the fuel

were examined as functions of conventional foam quality parameters, such as expansion ratio, drainage rate, and agent concentration. In field tests on fires ranging in area from 1500 to 48,000 sq ft suppression efficiency and burnback protection were measured as a function of foam quality and mode of application from various crash trucks. Yardsticks were defined to evaluate the efficiency of equipment and techniques, and two simple extinguishment models were developed. GRA

**N76-16057#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**LONG LINE LOITER: CONTINUOUS AIR DROP TO SMALL SITES Final Report**
Eric J. Jumper Aug. 1975 67 p refs
(AD-A017520; AMRL-TR-72-25) Avail: NTIS CSCL 15/7

It is envisioned that the Long-Line Loiter concept may be a simple solution to the long-standing problem of precise airborne delivery of personnel and supplies to selected ground locations. Recent studies of continuous resupply from a small aircraft revealed that a line can be accurately dropped to a small precise location on the ground while the aircraft maintains a comfortable altitude above this location, out of range of small arms fire. Once the aircraft is established in its orbit, loads of up to at least 200 pounds can be slid down the line to an anchor point, using conventional parachutes to check the rate of descent to approximately 40 feet/second at impact. Current studies provide the system parameters based on line length, parachute size, and matching of payloads and parachute canopies for optimum descent rates. These scaled values give the user the flexibility to reduce large loads to appropriate parcel sizes, yet insure no dispersal of the packages, regardless of the number, during delivery. GRA

# 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

**N76-16058*#** Massachusetts Inst. of Tech., Cambridge. Decision and Control Sciences Group.
**DESIGN AND SIMULATION OF A DESCENT CONTROLLER FOR STRATEGIC FOUR-DIMENSIONAL AIRCRAFT NAVIGATION M.S. Thesis**
Frederick M. Lax Nov. 1975 206 p refs
(Grant NGL-22-009-124; Contract DOT-TSC-982)
(NASA-CR-146127; ESL-R-632) Avail: NTIS HC $7.75 CSCL 17G

A time-controlled navigation system applicable to the descent phase of flight for airline transport aircraft was developed and simulated. The design incorporates the linear discrete-time sampled-data version of the linearized continuous-time system describing the aircraft's aerodynamics. Using optimal linear quadratic control techniques, an optimal deterministic control regulator which is implementable on an airborne computer is designed. The navigation controller assists the pilot in complying with assigned times of arrival along a four-dimensional flight path in the presence of wind disturbances. The strategic air traffic control concept is also described, followed by the design of a strategi control descent path. A strategy for determining possible times of arrival at specified waypoints along the descent path and for generating the corresponding route-time profiles that are within the performance capabilities of the aircraft is presented. Using a mathematical model of the Boeing 707-320B aircraft along with a Boeing 707 cockpit simulator interfaced with an Adage AGT-30 digital computer, a real-time simulation of the complete aircraft aerodynamics was achieved. The strategic four-dimensional navigation controller for longitudinal dynamics was tested on the nonlinear aircraft model in the presence of 15, 30, and 45 knot head-winds. The results indicate that the controller preserved the desired accuracy and precision of a time-controlled aircraft navigation system. Author

**N76-16059#** Alaska Univ., Fairbanks. Geophysical Inst.
**EFFECTS OF HIGH LATTITUDE GEOPHYSICAL EVENTS ON VHF AERONAUTICAL NAVIGATION AIDS, TASK A Final Report**
Ronald D. Rasmussen Sep. 1975 73 p refs
(Contract DOT-FA74WA-3356)
(AD-A018037/2; FAA-RD-75-136) Avail: NTIS HC $5.00 CSCL 17/7

The effects of geophysical disturbances such as auroras, solar flares and magnetic storms on VHF aeronautical navigation aids, in particular VOR, in high latitude regions, were studied. Recording VOR monitor stations were designed and assembled and subsequently installed at Ester Dome (Fairbanks VOR), Pedro Dome (Fairbanks VOR), and Hoonah (Sisters Island VOR). These monitor stations employed aircraft navigation receivers and antennas to duplicate, as much as possible, aircraft operating conditions. No appreciable effects on short range navigation signals were produced by solar fluxes, magnetic storms, and substorms, auroras, or solar noise. Author

**N76-16060#** Federal Aviation Administration, Washington, D.C. Spectrum Management Staff.
**AIRBORNE MEASUREMENTS OF VOR/LOCALIZER SIGNAL STRENGTH AND DESIRED TO UNDESIRED SIGNAL RATIOS. VOLUME 2: LOVE FIELD, DALLAS, TEXAS; WESTMORELAND FIELD, LATROBE, PENNSYLVANIA; 8-LOOP, V-RING AND TWIN T LOCALIZER ANTENNA TYPES Final Report**
Robert E. Evermart Nov. 1975 140 p ref 2 Vol.
(AD-A018034/9; FAA-RD-75-165-Vol-2) Avail: NTIS HC $6.00 CSCL 17/7

The results are presented of airborne measurements of signal strengths and select facility flyabilit6 recordings at Love Field, Dallas, Texas and Westmoreland Field, Latrobe, Pa. These measurements were conducted on three types of instrument landing system (ILS) arrays. Tests were conducted before and after conversion from 8-Loop to the specialized array by FAA flight inspection/facility installation teams. Author

**N76-16061*#** Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.
**FAILURE DETECTION AND ISOLATION INVESTIGATION FOR STRAPDOWN SKEW REDUNDANT TETRAD LASER GYRO INERTIAL SENSOR ARRAYS**
A. J. Eberlein and T. G. Lahm [1976] 100 p
(Contract NAS2-8065)
(NASA-CR-137730) Avail: NTIS HC $5.00 CSCL 17G

The degree to which flight-critical failures in a strapdown laser gyro tetrad sensor assembly can be isolated in short-haul aircraft after a failure occurrence has been detected by the skewed sensor failure-detection voting logic is investigated along with the degree to which a failure in the tetrad computer can be detected and isolated at the computer level, assuming a dual-redundant computer configuration. The tetrad system was mechanized with two two-axis inertial navigation channels (INCs), each containing two gyro/accelerometer axes, computer, control circuitry, and input/output circuitry. Gyro/accelerometer data is crossfed between the two INCs to enable each computer to independently perform the navigation task. Computer calculations are synchronized between the computers so that calculated quantities are identical and may be compared. Fail-safe performance (identification of the first failure) is accomplished with a probability approaching 100 percent of the time, while fail-operational performance (identification and isolation of the first failure) is achieved 93 to 96 percent of the time. Author

**N76-16062*#** Systems Control, Inc., Palo Alto, Calif.
**ORGANIZATION AND USE OF A SOFTWARE/HARDWARE AVIONICS RESEARCH PROGRAM (SHARP)**
J. S. Karmarkar and M. N. Kareemi Jul. 1975 110 p refs
(Contract NAS2-8344)
(NASA-CR-137676) Avail: NTIS HC $5.50 CSCL 01E

The organization and use is described of the software/hardware avionics research program (SHARP) developed to duplicate the automatic portion of the STOLAND simulator

system, on a general-purpose computer system (i.e., IBM 360). The program's uses are: (1) to conduct comparative evaluation studies of current and proposed airborne and ground system concepts via single run or Monte Carlo simulation techniques, and (2) to provide a software tool for efficient algorithm evaluation and development for the STOLAND avionics computer. Author

# 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

**N76-16063** Purdue Univ., Lafayette, Ind.
**THE OPTIMIZATION OF LOW-SPEED FLYING DEVICES BY GEOMETRIC PROGRAMMING Ph.D. Thesis**
John Hamilton McMasters 1975 191 p
Avail: Univ. Microfilms Order No. 76-560

The optimum design of low speed flying devices is investigated using the nonlinear optimization technique of geometric programming. Data are presented on the design, size, weight, performance, and energetic requirements of a range of devices from small insects through large transport aircraft. The consequences of the simple square-cube-law are compared with the data and an attempt is made to theoretically verify statistical relations between device energetic requirements and mass. The problem of optimizing a Kremer competition man-powered airplane is discussed. The derivation of an extensive mathematical model for large ultralight weight aircraft accounting for the effects of Reynolds number and drag rise in banked turning flight is included. It is concluded that a substantial pattern exists in the relations between geometric size, weight, and energetic requirements for the entire range of low-speed flying devices considered and that analyses of such data must include adequate consideration of Reynolds number, scaling effects, specific operation requirements, and the environment in which a particular device operates.Dissert. Abstr.

**N76-16064*#** Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering.
**AIRCRAFT MODEL PROTOTYPES WHICH HAVE SPECIFIED HANDLING-QUALITY TIME HISTORIES Final Technical Report**
S. H. Johnson Jan. 1976 150 p refs
(Grant NsG-4005)
(NASA-CR-146138) Avail: NTIS HC $6.00 CSCL 01C

Several techniques for obtaining linear constant-coefficient airplane models from specified handling-quality time histories are discussed. One technique, the pseudodata method, solves the basic problem, yields specified eigenvalues, and accommodates state-variable transfer-function zero suppression. The method is fully illustrated for a fourth-order stability-axis small-motion model with three lateral handling-quality time histories specified. The FORTRAN program which obtains and verifies the model is included and fully documented. Author

**N76-16065*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OH-58 HELICOPTER TRANSMISSION FAILURE ANALYSIS**
D. P. Townsend, J. J. Coy (Army Air Mobility Res. and Develop. Lab., Cleveland), and B. R. Hatvani Jan. 1976 35 p refs
(NASA-TM-X-71867; E-8633) Avail: NTIS HC $4.00 CSCL 01C

The OH-58 main transmission gearbox was run at varying output torques, speeds, and oil cooling rates. The gearbox was subsequently run to destruction by draining the oil from the gearbox while operating at a speed of 6200 revs per minute and 36,000 inch-pounds output torque. Primary cause of gearbox failure was overheating and melting of the planet bearing aluminum cages. Complete failure of the gearbox occurred in 28 1/2 minutes after the oil pressure dropped to zero. The alternating and maximum stresses in the gearbox top case were approximately 10 percent of the endurance limit for the material. Deflection of the bevel gear at 67000 inch-pounds output torque indicate a marginal stiffness for the bevel gear supporting system. Author

**N76-16066*#** Lockheed-Georgia Co., Marietta.
**CORRELATION OF C-5A ACTIVE LIFT DISTRIBUTION CONTROL SYSTEM (ALDCS) AEROELASTIC MODEL AND AIRPLANE FLIGHT TEST RESULTS**
H. D. McWhirter, W. W. Hollenbeck, and W. F. Grosser [1976] 199 p refs
(Contract NAS1-13731)
(NASA-CR-144903) Avail: NTIS HC $7.50 CSCL 01C

The C-5A aeroelastic wind tunnel model and airplane flight test results, each with an active lift distribution control system (ALDCS), are correlated on a one-to-one-basis. The ALDCS redistributes the outer wing lift to reduce wing-bending moments and maintains trim flight when the aircraft encounters vertical gusts and/or performs symmetrical maneuvers. The system responds electrically to vertical acceleration and pitch rate to command aileron and inboard elevator deflections. The primary data presented are aeroelastic responses to oscillating aerodynamic controls. The correlation shows that an aeroelastic model is a useful tool in the development of active control technology and systems. Author

**N76-16067*#** Joint Publications Research Service, Arlington, Va.
**HELICOPTERS ON THE BAYKAL-AMUR LINE**
V. A. Nazarov Washington NASA Feb. 1976 52 p Transl. into ENGLISH from Izd. Transp. (Moscow), 1975 p 1-72
(NASA Order W-13183)
(NASA-TT-F-16869) Avail: NTIS HC $4.50 CSCL 01C

Flight performance and technical specifications of the Mi-8, Mi-6, Mi-10K, Mi-2, Ka-26, Mi-4 and Mi-1 helicopters are reported in relation to their use in the construction of the Baykal-Amur Line. The book is designed for pilots, technical personnel and construction leaders and workers on the Line. Author

**N76-16068#** Loughborough Univ. of Technology (England). Dept. of Transport Technology.
**LIGHT AIRCRAFT DESIGN PROJECTS 1972: LUTRAC AND TWILIGHT**
L. R. Jenkinson May 1975 27 p Presented at the Can. Aeron. and Space Inst. Symp. on Recreational Aircraft, Ottawa, 23-25 Jun. 1975
(TT-7505) Avail: NTIS HC $4.00

Two light aircraft design studies undertaken by finalist students studying aeronautical engineering and design are described. The first study: the formula 1 racer Lutrac (Loughborough University Tourer/Racer Aircraft) concerns the postulating of a new formula for air racing and, therefore, the design of an aircraft to compete in this class. The second study: Twilight (Twin Light aircraft) results from the desirability to reduce the minimum size of twin-engined light aircraft in order to affect lower initial and operating costs. The major parameters affecting the aircraft size are the airworthiness criterion for flight performance following engine failure and the availability of engines at a power to match the above requirements. Some modifications to the aircraft specifications are shown to be necessary and these changes would be incorporated in further design work. ESA

**N76-16069#** Boeing Vertol Co., Philadelphia, Pa.
**CH-47C FIXED-SYSTEM STALL-FLUTTER DAMPING Final Report, Feb. 1974 - Mar. 1975**
Joseph M. Baskin Aug. 1975 37 p refs
(Contract DAAJ02-74-C-0029; DA Proj. 1F2-62208-AH-90)
(AD-A014890; USAAMRDL-TR-75-29) Avail: NTIS CSCL 01/3

This program was conducted to evaluate the effect of fixed-system damping on stall-induced control loads. Damping was introduced into the CH-47C aft-rotor control system by connecting the housing portion of the linear damper to the longitudinal-trim system and grounding the piston portion of the damper to the aft transmission. Five damper-rate configurations were evaluated on a helicopter with a gross weight of 40,000 pounds. Data obtained in speed sweeps at five density altitudes to 10,000 feet indicate that the rotating-system loads were reduced by 16 percent and the fixed-system loads were reduced by 22 percent. The program proved that fixed-system damping is effective in reducing stall-induced control loads. Recommendations are presented for reducing these loads by softening the

swashplate support as well as by increasing the effectiveness of the fixed-system damper. Author (GRA)

**N76-16070#** Technology, Inc., Dayton, Ohio.
**APPROXIMATIONS TO THE DISTRIBUTIONS OF THE DETERMINANTS OF REAL AND COMPLEX MULTIVARIATE BETA MATRICES Technical Interim Report**
J. C. Lee, P. R. Krishnaiah, and T. C. Chang Wright-Patterson AFB, Ohio ARL Jun. 1975 49 p refs
(Contract F33615-73-C-4155)
(AD-A015050; ARL-75-0168) Avail: NTIS CSCL 01/3

In this report, the authors have approximated the distributions of certain powers of the determinants of the real and complex multivariate beta matrices with suitable Pearson type distributions. Using these approximations, the authors constructed percentage points of the distributions of the above determinants. The usefulness of these tables is illustrated with the data on the vibrations of a C-5A aircraft. GRA

**N76-16071#** United Technologies Corp., Stratford, Conn. Sikorsky Aircraft Div.
**FAN-IN-TAILCONE VEHICLE DEFINITION RESULTING FROM ENGINE/TRANSMISSION/AIRFRAME Final Report, 28 May 1974 - 28 May 1975**
M. L. Potash Jul. 1975 148 p refs
(Contract DAAJ02-74-C-0042; DA Proj. 1G2-62207-AH-89)
(AD-A015000; SER-50911; USAAMRDL-TR-75-28) Avail: NTIS CSCL 01/1

The study objective was identification of innovative engine/transmission/airframe concepts that provide total airflow and power management to meet the projected requirements of future Army helicopters with minimum effect on vehicle performance. A study system specification for a reconnaissance helicopter was developed, and a current-technology baseline air vehicle was synthesized. Advanced subsystem concepts were developed including integration of the IR suppression/directional control subsystem, dynamic components, airframe components, and airflow subsystems. GRA

**N76-16072#** Dayton Univ. Research Inst., Ohio.
**HELICOPTER FATIGUE LOAD AND LIFE DETERMINATION METHODS Final Report, Mar. 1974 - Mar. 1975**
John Patrick Ryan, Alan P. Berens, Richard G. Coy, and George J. Roth Aug. 1975 74 p refs
(Contract DAAJ02-74-C-0031; DA Proj. 1F2-62208-AH-90)
(AD-A014998; USAAMRDL-TR-75-27) Avail: NTIS CSCL 01/3

Fatigue life estimation of helicopter dynamic components is a complex process that is currently achieved through many different methods. The objective of this study was to review existing methods and to develop a standardized method that could be used by the Army for reliably predicting operational life. This report presents results of a detailed review of fatigue life methods used by five helicopter manufacturers as determined by site visits and literature reviews. Recommendations for a standardized method are presented in areas of mission spectra definition, flight strain survey techniques, laboratory fatigue strength characterization, and safe-life calculation procedures. GRA

**N76-16073#** Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
**REMOTELY PILOTED VEHICLE/VERTICAL ATTITUDE TAKE-OFF AND LANDING DEMONSTRATION VEHICLE Final Report**
Warren H. Eilertson Aug. 1975 19 p refs
(AD-A014873; AERO-1209; NSRDC-4697) Avail: NTIS CSCL 01/3

Launch and recovery of RPV's aboard ship has been identified by the Navy as a major design impact area. Vertical attitude take-off and landing offers attractive advantages to the Navy in that ship/RPV interface problems are alleviated. To assess these advantages the Aviation and Surface Effects Department at the Naval Ship Research and Development Center (NSRDC), has designed and constructed a 560 lb demonstration vehicle. This vehicle during 1975 will be flight tested to assess vertical hover capability of the RPV in the turbulent aerodynamic wake generated by a ships superstructure while underway. GRA

**N76-16074#** Rochester Applied Science Associates, Inc., N.Y.
**THE DEVELOPMENT AND APPLICATION OF AN ANALYSIS FOR THE DETERMINATION OF COUPLED TAIL ROTOR/HELICOPTER AIR RESONANCE Final Report**
Lawrence R. Sutton and Santu T. Gangwani Aug. 1975 162 p refs
(Contract DAAJ02-74-C-0026; DA Proj. 1F2-62209-AH-76)
(AD-A014989; RASA/SRL-75-01; USAAMRDL-TR-75-35)
Avail: NTIS CSCL 01/3

An analysis and associated computer program have been developed to provide a highly sophisticated mathematical representation of coupled tail rotor/support structure systems. The coded analysis allows the consideration of an anisotropically supported flexible swashplate control system, rotor drive shaft torsional flexibility, anisotropic mounting of the gearbox about two mutually orthogonal axes, and an elastic support structure such as a fuselage-tailboom-fin structure in addition to the rotor system. As such, the analysis can also be applied to main rotor systems. The resulting analysis has the capability of predicting the air resonance (frequency, stability, and mode shape) behavior of a coupled tail rotor/support structure system in hover and forward flight where the rotor may be of a rigid, teetering, gimballed, flexstrap, or partial to fully articulated type. The blade aerodynamics representation including both quasi-steady and unsteady (Theodorsen's) terms can utilize either a uniform or a variably defined induced velocity field and up to five types of airfoil sections. All blade and fuselage-tailboom-fin structure characteristics required to adequately represent these structures in a lumped parameter form are considered, including inertia and gyroscopic damping effects. The analysis includes aerodynamic interharmonic blade coupling and interharmonic coupling due to support structure behavior. GRA

**N76-16075#** Army Engineer Waterways Experiment Station, Vicksburg, Miss.
**A STUDY OF THE EFFECTS OF BRAKING ON DRAG FORCE AND SINKAGE Final Report, Jun. - Dec. 1966**
J. L. Smith and G. W. Turnage Aug. 1975 51 p refs Sponsored by AF
(AFWL Proj. 73-191)
(AD-A014912; AFWL-TR-74-315) Avail: NTIS CSCL 01/3

In modern warfare it may be necessary to airlift men and supplies into areas of operations where airfields do not exist, are too few, or are too far away for proper support operations. It is suggested that cargo aircraft land on unsurfaced runways with only minimum preparation. This requires landing gear designed to withstand the drag force and wheel sinkage associated with soft soils. To determine the effect of braking on drag force and sinkage, and to ascertain the feasibility of scale modeling the equipment involved, braked wheel tests were conducted at low forward speed in a desert sand environment, using specified tires. The results are analyzed. GRA

**N76-16076#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**AN ANALYSIS OF DECISION CRITERIA FOR THE SELECTION OF F-16 RELIABILITY IMPROVEMENT INCENTIVE ALTERNATIVES M.S. Thesis**
Thomas B. Koegel and Nathan B. Mills, Jr. Sep. 1975 195 p refs
(AD-A014786; GSM/SM/75S-4) Avail: NTIS CSCL 01/3

The F-16 Air Combat Fighter development and acquisition contract includes special logistic supportability incentive alternatives for certain critical subsystems which have been designated as control First Line Units. The alternatives are a contractor commitment to a Target Logistic Support Cost, a Reliability Improvement Warranty, and a Reliability Improvement Warranty with guaranteed mean time between failure. The Reliability Improvement Warranties may be selected at either a First Line Unit or module level. This report analyzes those alternatives from a Government benefit point of view to assist in the final selection process. A methodology is developed to compute significant costs to the Government over the equipment operational lifetime for each alternative, with the exception of module level Reliability Improvement Warranties. The procedure and results of the methodology are demonstrated for two selected F-16 First Line Units: the Flight Control Computer and the Heads

Up Display Electronics. Limitations and assumptions of the methodology are identified and discussed. GRA

**N76-16077#** Army Aviation Systems Command, St. Louis, Mo.
**MAJOR ITEM SPECIAL STUDY (MISS), OH-58A FREE-WHEELING ASSEMBLY Interim Report, 1 Oct. 1969 - 31 May 1974**
Aug. 1975 21 p
(AD-A014895; USAAVSCOM-TR-75-33) Avail: NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA form 2410 reportable components. These are time change items and certain condition change items selected because of high cost or need for intensive management. Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report. The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting. From this data, removal distributions can be plotted and an MTR (mean time to removal) can be calculated. The MISS reports then investigate possible cost savings based on total elimination of selected failure modes. These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas. Author (GRA)

# 06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

**N76-16078#** Hughes Aircraft Co., Culver City, Calif. Display Systems Lab.
**IMAGE ENHANCEMENT TECHNIQUES FOR COCKPIT DISPLAYS Final Report, 1 Apr. - 1 Oct. 1974**
David J. Ketcham, Roger W. Lowe, and J. William Weber Dec. 1974 79 p
(Contract N00014-74-C-0313; NR Proj. 213-124)
(AD-A014928; HAC-P74-530R; HAC/Ref-D0802) Avail: NTIS CSCL 01/3

The major objective of this research program was to develop and evaluate three techniques for the real-time enhancement of sensor displays in the airborne cockpit environment. Two enhancement techniques developed and optimized for contrast enhancement are Local Area Brightness and Gain Control (LABGC) and Local Area Histogram Equalization (LAHE). Haar Transform Crispening (HTC) is another technique that was developed and optimized during this program. HTC may be used to sharpen edges in an image which are blurred due to misfocused optics or MTF roll-off. An evaluation of the enhancement techniques includes subjective evaluations for specific operator tasks and a comparison of mechanization complexities. Photographs of original and enhanced images are included. GRA

# 07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

**N76-16079** Engineering Sciences Data Unit, London (England).
**AERONAUTICAL SERIES. AERODYNAMICS SUB-SERIES. VOLUME 1. NOISE Collection of Data Items**
1 Apr. 1975 6 p 6 data items in 1 binder
(ESDU/N) For information on availability of series, sub-series, or individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161 (write for prices)

The data items analyze the sources of jet engine noise and investigate the effectiveness of acoustic liners. Author

**N76-16080*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STATUS REVIEW OF NASA PROGRAMS FOR REDUCING AIRCRAFT GAS TURBINE ENGINE EMISSIONS**
Richard A. Rudey [1976] 23 p refs Presented at the 3d Intern. Symp. on Air Breathing Engines, Munich, 7-12 Mar. 1976
(NASA-TM-X-71861; E-8620) Avail: NTIS HC $3.50 CSCL 21E

Programs initiated by NASA to develop and demonstrate low emission advanced technology combustors for reducing aircraft gas turbine engine pollution are reviewed. Program goals are consistent with urban emission level requirements as specified by the U. S. Environmental Protection Agency and with upper atmosphere cruise emission levels as recommended by the U. S. Climatic Impact Assessment Program and National Research Council. Preliminary tests of advanced technology combustors indicate that significant reductions in all major pollutant emissions should be attainable in present generation aircraft gas turbine engines without adverse effects on fuel consumption. Preliminary test results from fundamental studies indicate that extremely low emission combustion systems may be possible for future generation jet aircraft. The emission reduction techniques currently being evaluated in these programs are described along with the results and a qualitative assessment of development difficulty. Author

**N76-16081*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECTS OF AIRPLANE CHARACTERISTICS AND TAKE-OFF NOISE AND FIELD LENGTH CONSTRAINTS ON ENGINE CYCLE SELECTION FOR A MACH 2.32 CRUISE APPLICATION**
John B. Whitlow, Jr. Jan. 1976 49 p refs
(NASA-TM-X-71865; E-8631) Avail: NTIS HC $4.00 CSCL 01C

Sideline noise and takeoff field length were varied for two types of Mach 2.32 cruise airplane to determine their effect on engine cycle selection. One of these airplanes was the NASA/Langley-LTV arrow wing while the other was a Boeing modified delta-plus-tail derived from the earlier 2707-300 concept. Advanced variable cycle engines were considered. A more conventional advanced low bypass turbofan engine was used as a baseline for comparison. Appropriate exhaust nozzle modifications were assumed, where needed, to allow all engines to receive either an inherent co-annular or annular jet noise suppression benefit. All the VCE's out-performed the baseline engine by substantial margins in a design range comparison, regardless of airplane choice or takeoff restrictions. The choice among the three VCE's considered, however, depends on the field length, noise level, and airplane selected. Author

**N76-16082*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LIP NOISE GENERATED BY FLOW SEPARATION FROM NOZZLE SURFACES**
W. Olsen and A. Karchmer [1975] 29 p refs Presented at the 14th Aerospace Sci. Meeting, Washington, D. C., 26-28 Jan. 1976; sponsored by AIAA
(NASA-TM-X-71859; AIAA-Paper-76-3) Avail: NTIS HC $4.00 CSCL 20D

The results of a series of experiments, performed to investigate flow separation and classic lip noise and to aid in understanding aeroacoustic noise generation are presented. Several types of nozzle-lip configurations were used to study the high frequency noise generated by small regions of flow separation at the nozzle lip. These included coaxial nozzles, and circular and slot nozzles with splitter plates. The jet flow velocity was varied and far field noise was measured for all nozzle-lip geometries (coaxial and splitter plate). The effect of a velocity difference across the lip of the coaxial nozzle and the splitter plate on the far field noise was also measured. Finally, an effort was made to find means to reduce the high frequency noise caused by flow separation at the lip. Author

**N76-16083#** MAN-Acoustics and Noise, Inc., Seattle, Wash.
**NOISE CERTIFICATION CRITERIA AND IMPLEMENTATION CONSIDERATIONS FOR V/STOL AIRCRAFT Final Report**
Nov. 1975 82 p refs
(Contract DOT-FA74WAI-490)
(AD-A018036/4; MAN-101M; FAA-RD-75-190) Avail: NTIS HC $5.00 CSCL 20/1

Although this first phase of a two-phase program emphasized the extent that perceived noise level in PNdB, perceived level in dBA, and corrections to these engineering calculation procedures reflected annoyance to next generation STOL aircraft noise signatures, other aspects of certification implementation were also considered. As a means of determining the accuracy and reliability of engineering calculation procedures that could be utilized as a basis for noise certification of V/STOL commercial aircraft, 36 persons made annoyance judgements to 34 noise signals presented at 5 different levels. The signals included recordings of conventional jet aircraft operations, turboprop and reciprocating engine powered commercial aircraft, helicopter flybys, and simulations of V/STOL operations. Both relative annoyance and absolute acceptability judgements were obtained. Some of the results are: (1) for flyover (not hover) operations EPNdB validly and reliably predicts annoyance, (2) for hover type of operations EPNdB under predicts annoyance, (3) when applied to all aircraft types, the FAR-36 tone correction degrades reliability for both PNdB and dBA while the duration correction improves reliability to a significant extent, and (4) a difference between calculated and judged values should be equal to or greater than 3 EPNdB in order to conclude that the difference is reliable. Author

**N76-16084#** Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
**THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF AEROTHERMODYNAMIC CONTROL OF AIRCRAFT JET PROPULSION SYSTEMS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUR AEROTHERMODYNAMISCHEN UEBERWACHUNG VON LUFTFAHRT-STRAHLTRIEBWERKEN]**
Manfred Ziegner 1974 159 p refs In GERMAN
(ILR-2-1974; ISBN-3-7983-0532-3) Avail: NTIS HC $6.75

The aerothermodynamic control of aircraft jet engines was investigated in order to study automatic (without taking the engine apart) indication and localization of propulsion system failures. The problem of the theoretical values for propulsion control is discussed and an analysis of the influencing factors was made. Failure localization is discussed and the measurement method and data collection and data processing techniques are considered. Finally, experimental investigations are presented. ESA

**N76-16085#** European Space Agency, Paris (France).
**THE EFFECT OF THE ROTATIONAL SPEED OF A VANELESS DIFFUSER ON THE PERFORMANCE OF A CENTRIFUGAL COMPRESSOR**
Christian Fradin Nov. 1975 104 p refs Transl. into ENGLISH of "Influence de la Vitesse de Rotation d'un Diffuseur Lisse sur les Performances d'un Compresseur Centrifuge", ONERA, Paris Report ONERA-NT-218, 1974
(ESA-TT-202; ONERA-NT-218) Avail: NTIS HC $5.50

The loss of total pressure in the vaneless diffuser of a centrifugal compressor is mainly due to fluid friction with the walls. The losses can be reduced if the walls are rotated at an angular velocity less than that of the impeller. A method is described for calculating the three-dimensional boundary layer as a function of the angular velocity of the diffuser, together with the experimental results obtained with several diffuser configurations. A parametric study then enables the losses due to disk friction resulting from this concept to be determined. Th3 diffuser efficiency can be increased by up to 25 %. This results in an increase in the overall efficiency of the compressor of 2 to 4.5 %. Author (ESA)

**N76-16086#** Wyle Labs., Inc., El Segundo, Calif.
**REVIEW OF EXPERIMENTAL DATA IN SUPPORT OF A PROPOSED NEW METHOD FOR COMPUTING ATMOSPHERIC ABSORPTION Final Report**
Louis C. Sutherland May 1975 95 p refs
(Contract DOT-PS-40804)
(PB-245016/1; WCR-75-75-7; DOT-TST-75-87) Avail: NTIS HC $5.00 CSCL 20A

A brief outline of the method is given and a detailed comparison is also given between experimental data and values predicted by the model in its present form. This prediction method is based on a more accurate physical model of atmospheric attenuation than employed for previous prediction methods. In general, it shows good agreement for the normal range of atmospheric conditions with laboratory data and air-to-ground aircraft sound propagation measurements when the latter are based on measured atmospheric conditions over the propagation paths. However, improved data base is required for sound absorption at low frequencies, very low humidities, and wt temperatures outside the range of 0 to 25. GRA

**N76-16087#** United Technologies Corp., South Windsor, Conn. Engineering Facility.
**HIGH POWER DENSITY FUEL CELL FOR AIRCRAFT HIGH POWER Final Report, 1 Apr. 1972 - 31 Mar. 1975**
Alfred P. Meyer and William F. Bell May 1975 284 p
(Contract F33615-72-C-1371; AF Proj. 3145)
(AD-A014828; FCR-0003; AFAPL-TR-75-43) Avail: NTIS CSCL 10/2

Pratt and Whitney Aircraft has conducted an analytical and experimental program which demonstrated the feasibility of an ultra-lightweight fuel cell powerplant, with a specific weight of less than 0.5 lb/kw, for advanced aircraft applications. Full-scale single cells and 12-cell development units, the basic modular repeating subsection of which a complete powerplant is assembled, were constructed and successfully tested. Power densities up to 3000 watts/sq ft were demonstrated; this level is almost 50 percent greater than that required for a competitive flightweight system. Endurance tests demonstrated an operating capability in excess of 600 baseline missions. Several complete power systems based on the as-demonstrated performance were defined. These systems included all equipment required for a flight operational installation; i.e., powerplants, a reactant supply system, and a cooling water supply system. Each offers the advantages of instant 'on-off' power supply capability and modular design. Modular design provides the flexibility to meet a broad range of Air Force mission requirements without adverse impact on performance or development schedule and cost. Author (GRA)

**N76-16088#** United Technologies Corp., South Windsor, Conn. Engineering Facility.
**HIGH POWER DENSITY FUEL CELL FOR AIRCRAFT HIGH POWER, SUPPLEMENTAL Technical Report, 1 Apr. - 31 May 1975**
Alfred P. Meyer Jun. 1975 28 p
(Contract F33615-72-C-1371; AF Proj. 3145)
(AD-A014829; FCR-0047; AFAPL-TR-75-62) Avail: NTIS CSCL 10/2

Power Systems Division has conducted a two-month program to investigate the effect of increased operating pressure on the performance of lightweight high power density fuel cells. A lightweight cell had been operated during previous investigations at 60 psia to power densities as high as 2320 watts/sq ft. In this program the capability was evaluated at pressures of 60, 90, 120, 150, and 180 psia. Increasing operating pressures to 180 psia increased cell power density to 3890 watts/sq ft. Endurance tests verified stable cell operation at the increased power density levels. These tests show that operation of high power density fuel cells at higher than current baseline pressure levels can significantly improve cell performance and reduce powerplant and power system weight and volume. Author (GRA)

**N76-16089#** Mitsubishi Heavy-Industries Ltd., Tokyo (Japan).
**A STUDY ON THE TRANSONIC TURBINE CASCADE BY SHOCK TUNNEL**
Yasuo Kuramoto, Takehiko Nagayama, and Masamichi Imaizumi Jun. 1975 8 p refs
(PB-244857/9; MTB-101) Avail: NTIS HC $3.50 CSCL 21E

A pressure measurement method of the transonic flow through the turbine cascade by means of a shock tunnel is described. The present method using silicon oil containing tubes is characterized by an improvement of the response of the pressure-time relationship. Comparisons are made between the

present method and the optical method for the static pressure of the blade surfaces, and this method is adopted for supersonic Pitot tubes in order to obtain the two-dimensional losses of the cascade. GRA

**N76-16090#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**TEST OF A SUPERSONIC AXIAL COMPRESSOR STAGE INCORPORATING SPLITTER VANES IN THE ROTOR Interim Report, 1 Dec. 1972 - 31 Dec. 1974**
A. J. Wennerstrom, W. A. Buzzell, and R. D. DeRose Jun. 1975 431 p refs
(AF Proj. 7065)
(AD-A014732; ARL-75-0165) Avail: NTIS CSCL 21/5

Complete experimental results are presented from tests of an axial-compressor stage designed for a tip speed of 1600 ft/sec, a stage total pressure ratio of 3.06, and an inlet hub/tip radius ratio of 0.75. The rotor had been redesigned to incorporate a splitter vane between each pair of principal airfoils. At design speed, the compressor passed 88 percent of design flow, achieved a stage total pressure ratio of 2.77, and achieved isentropic efficiencies of 0.846 for the rotor and 0.674 for the stage. This represented a major improvement over the preceding configuration tested without rotor-splitter vanes. Future tests are to include various types of boundary-layer control. GRA

**N76-16091#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
**A COMPUTER SIMULATION OF THE TRANSIENT BEHAVIOR OF THE COMPRESSOR RESEARCH FACILITY INLET SYSTEM Technical Report, Jul. 1974 - Jan. 1975**
Stephen J. Przybylko Jul. 1975 138 p refs
(AF Proj. 3066)
(AD-A015046; AFAPL-TR-75-516) Avail: NTIS CSCL 21/5

This report describes a digital computer simulation of the dynamics of the inlet and its control for a compressor research facility. The simulation uses lumped parameters and the Tustin method for the dynamic terms. The report discusses the convergence technique used for iteration and a Bode analysis performed to determine the gains for the proportional plus integral control used to position the inlet valves. GRA

**N76-16092#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
**EVALUATION OF AN ELECTROSTATIC PROBE TECHNIQUE FOR DETECTION OF TURBINE ENGINE GAS PATH DISTRESS Final Comprehensive Summary Report, Jun. 1972 - Jun. 1974**
Donald A. Mitchell and Mario Soliz Mar. 1975 27 p refs
(AF Proj. 3066)
(AD-A014804; AFAPL-TR-74-96) Avail: NTIS CSCL 21/5

An electrostatic probe technique for prediction of imminent failure of turbine engine gas path components has been evaluated and found to be unsuitable for practical application. The proposed method necessitates detection of metal particles released into the engine gas flow during engine deterioration by use of a charge sensitive electrode in the turbine exhaust. The overall evaluation of this technique included combustor and plasma studies, theoretical efforts, and turbine evaluation, including testing under induced distress conditions. Fundamental limitations of the electrostatic probe method were found to be the elusive and many faceted nature of probe signals, the dependence of signals on the variable (and as yet undefined) plasma characteristics of the turbine exhaust, and the inability to establish a credible theory which was consistent in explaining test results. GRA

**N76-16093#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
**INTEGRAL ENGINE INLET PARTICLE SEPARATOR. VOLUME 2: DESIGN GUIDE**
Robert J. Duffy and Bernard F. Shattuck Aug. 1975 238 p refs
(Contract DAAJ02-73-C-0004; DA Proj. 1G1-62204-AA-71)
(AD-A015064; USAAMRDL-TR-75-31B-Vol-2) Avail: NTIS CSCL 21/5

Volume 2 of this report is a design guide for integral engine inlet separators in the 2 to 15 lb/sec size range. The separators are designed to remove sand, dust, and single foreign objects from the air entering a turboshaft engine. The procedures are based on results of a 30-month program to design and evaluate integral separators in 2, 5, and 15 lb/sec sizes. Also included are procedures developed during the development of an integral inlet separator for the T700-GE-700 engine. A definition of a turboshaft engine environment in terms of sand, dust, and foreign objects is included in Appendix A. Appendix B describes the analysis of individual particle trajectories in separators to predict sand separation efficiency. GRA

**N76-16094#** Environmental Protection Agency, Washington, D.C. Office of Noise Abatement and Control.
**PASSENGER NOISE ENVIRONMENTS OF ENCLOSED TRANSPORTATION SYSTEMS**
Jun. 1975 155 p refs
(PB-245409/8; EPA-550/9-75-025) Avail: NTIS HC $6.75 CSCL 20A

To determine the extent to which noise environments of enclosed transportation systems are deleterious to passenger health, an analysis was made of both information collected by past transportation studies and of new data collected for this project. The analysis consisted of identifying trends among various transportation modes, noting areas of data deficiency, calculating the effect of noise exposure on health under various assumptions of travel duration and workplace noise exposure levels, and assessing measurement methodologies. GRA

**N76-16095#** Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
**ANALYSIS OF RESPONSE REQUIREMENTS FOR V/STOL LIFT/CRUISE ENGINES USED TO PROVIDE HEIGHT AND MOMENT CONTROL Final Report**
J. W. Clark, Jr. 30 Jun. 1975 78 p refs
(AD-A014868; NADC-75037-30) Avail: NTIS CSCL 01/3

Parametric investigations were performed to determine constraints imposed by handling qualities requirements on a V/STOL lift/cruise propulsion system when used to provide at least a portion of the vehicle moment control. Primary emphasis was placed on defining the magnitude of engine response time and incremental thrust necessary to satisfy the applicable requirements of the V/STOL Flying Qualities Specification, MIL-F-83300. Where possible the results were normalized by baseline aircraft parameters to eliminate configuration dependence. GRA

## 08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

**N76-16096** Purdue Univ., Lafayette, Ind.
**THE EFFECTS OF STABILITY AUGMENTATION ON THE GUST RESPONSE OF A STOL AIRCRAFT DURING A CURVED MANUAL APPROACH Ph.D. Thesis**
Milton Beverly Porter, Jr. 1975 230 p
Avail: Univ. Microfilms Order No. 76-579

A parametric variation of the open loop poles of a STOL aircraft was made using stability augmentation system (SAS) gains, and the gust response of the manually piloted aircraft was analyzed at points on an MLS approach path. The study was reduced to two quadratic optimal control problems for linear infinite time stochastic systems: (1) to compute the SAS gains using a rate-model-in-the-performance-index pole placement algorithm, and (2) to calculate the pilot gains and systems gust response using a quadratic optimal pilot model. Both the SAS and pilot gains calculation yielded reasonable low gains for all cases, and the four lateral-directional poles and the longitudinal short period poles could be placed accurately. Dissert. Abstr.

**N76-16097** West Virginia Univ., Morgantown.
**ASYMMETRIC ENTRAINMENT OF 2-D CURVED JETS Ph.D. Thesis**
Subrato Chandra 1975 192 p
Avail: Univ. Microfilms Order No. 76-759

The entrainment aspect of two dimensional thick curved jets is theoretically analyzed to predict curved jet characteristics needed for an accurate mathematical modeling of two dimensional lifting jets. An integral method analysis of the curved jet is performed using incompressible, fully turbulent, curved, free jet equations. The streamwise jet edge velocities are obtained from a nonlinear interactive potential flow analysis of a thin jet issuing from the trailing edge of a hinged flat plate. This simple geometry is representative of the two dimensional curved jets of V/STOL wing sections in transition flight. The results are in agreement with available straight and curved jet results. Jet growth and total pressure rates are predicted which are only slightly greater than the straight jet at corresponding velocity ratio even near the jet exit where curvature effects are prominent.Dissert. Abstr.

**N76-16098*#** Colorado Univ., Colorado Springs.
**DESIGN OF NONINTERACTING FLIGHT CONTROL SYSTEMS IN THE PRESENCE OF LARGE PARAMETER VARIATIONS Semiannual Status Report, 1 Jul. 1975 - 1 Jan. 1976**
Shih-Ho Wang and Peter Dorato 1 Jan. 1976 11 p refs
(Grant NsG-1213)
(NASA-CR-146129) Avail: NTIS HC $3.50 CSCL 01C

The perfect noninteraction for a discrete parameter set is examined along with the sensitivity of a decoupled flight control system with respect to system parameter variations. A set of computer programs developed for this project are described. Author

**N76-16099*#** Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
**AN ANALYTICAL STUDY OF EFFECTS OF AEROELASTICITY ON CONTROL EFFECTIVENESS Progress Report, period ending 31 Dec. 1975**
Sudhir C. Mehrotra Dec. 1975 141 p refs
(Grant NsG-1046)
(NASA-CR-146140; PR-3) Avail: NTIS HC $6.00 CSCL 01C

Structural influence coefficients were calculated for various wing planforms using the KU Aeroelastic and NASTRAN programs. The resulting matrices are compared with experimental results. Conclusions are given. Author

**N76-16100*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**AN ANALYTICAL STUDY OF AIRCRAFT LATERAL-DIRECTIONAL HANDLING QUALITIES USING PILOT MODELS**
James J. Adams and Frederick L. Moore (Army Air Mobility Research Development Lab., Hampton, Va.) Washington Jan. 1976 54 p refs
(NASA-TN-D-8103; L-8452) Avail: NTIS HC $4.50 CSCL 01C

A procedure for predicting lateral-directional pilot ratings on the basis of the characteristics of the pilot model and the closed-loop system characteristics is demonstrated. A correlation is shown to exist between experimentally obtained pilot ratings and the computed pilot ratings. Author

**N76-16101#** Systems Research Labs., Inc., Dayton, Ohio.
**HUMAN FACTORS EVALUATION OF SEVERAL CONTROL SYSTEM CONFIGURATIONS INCLUDING WORK LOAD SHARING WITH FORCE WHEEL STEERING DURING APPROACH AND FLARE Final Report, Jan. 1971 - Dec. 1974**
Mark S. Crabtree Apr. 1975 103 p refs
(Contract F33615-75-C-3050; AF Proj. 8226)
(AD-A014836; SRL-6848-00-18; AFFDL-TR-75-43) Avail: NTIS CSCL 01/3

An experiment was conducted to evaluate the performance and workload characteristics of six types of aircraft control system configurations during simulated IFR approaches. The six types were, (1) manual ILS, (2) manual approach with flight director, (3) semi-automatic approach with flight director in which the pitch, roll, and yaw axes of the autopilot were controlled by the pilot through force wheel steering, (4) and (5) two workload sharing approaches with force wheel steering and flight directors where, in one case, the pilot controlled pitch and power while the co-pilot controlled roll and yaw and, in the other case, the roles of the pilot and co-pilot were interchanged, and finally (6) a fully automatic approach. GRA

# 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

**N76-16102#** National Aeronautical Establishment, Ottawa (Ontario).
**[AIRFOIL STUDIES IN NAE 5 ft x 5 ft WIND TUNNEL, SECOND-ORDER WAVE RESEARCH, AND CURRENT PROJECTS] Quarterly Bulletin, 1 Jul. - 30 Sep. 1975**
Sep. 1975 92 p refs
(DME/NAE-1975(3); ISSN-0047-9055) Avail: NTIS HC $5.00

The NAE wind tunnel is described with emphasis on the facility's usefulness in modern airfoil development. Results are presented from investigations of a large variety of airfoils, demonstrating the effect of Reynolds number on airfoil characteristics. A brief description of wave drift forces is given along with a listing of current research in various areas, including: control systems and human engineering; engine design; fuels and lubricants; gas dynamics; high speed aerodynamics; low speed aerodynamics; marine dynamics; low temperature research; structures and materials; and unsteady aerodynamics. J.M.S.

**N76-16103*#** California State Univ., Sacramento.
**THERMAL AREA EFFECTIVENESS FOR FUTURE AIRCRAFT Final Report, 1 Jul. - 31 Oct. 1974**
W. W. Happ 5 Feb. 1975 101 p refs
(Grant NCAR-655-501)
(NASA-CR-137801) Avail: NTIS HC $5.50 CSCL 01E

Problem areas in airport planning, design, and operations identified by a decision matrix developed to display various airport functions interfaced with facilities and an extensive literature survey were investigated. Areas considered include: site selection and growth potential; emissions and noise control/containment for airports; financial and legal aspects of airport planning, contruction, and operation; intra-airport transportation and other passenger flow facilitators; simulation and modeling for airports; guidelines for airport multimodal access planning. Results are summarized and a bibliography is included. J.M.S.

**N76-16104*#** Martin Marietta Corp., Denver, Colo.
**REVITALIZING THE HYDRODYNAMIC SUPPORT FOR SPACE SHUTTLE**
Gordon Sholes Nov. 1975 48 p refs
(Contract NAS8-31616)
(NASA-CR-144149; MCR-75-457) Avail: NTIS HC $4.00 CSCL 14B

The condition of the equipment retained from the Saturn V hydrodynamic support (HDS) is described along with the work necessary to supplement, modify, and refurbish it for the space shuttle mated vehicle ground vibration test (MVGVT). The design changes necessary to adapt the Saturn V HDS design for the space shuttle are described and the results of the inventory and inspection are given. Author

**N76-16105#** National Aviation Facilities Experimental Center, Atlantic City, N.J.
**EVALUATION OF AN AIRPORT LIGHTING CONTROL AND DISPLAY SYSTEM Final Report, Sep. 1974 - Jun. 1975**
E. Leon Reamer Oct. 1975 14 p
(AD-A018635/6; FAA-NA-75-55; FAA-RD-75-158) Avail: NTIS HC $4.00 CSCL 01/5

The result of tests that were conducted to evaluate an airport lighting control and display system to determine its suitability to control airport lighting are presented and the techniques used are described. A mimic control and display system was developed and installed at the National Aviation Facilities Experimental

Center. It was tested to determine its ability to: (1) expedite the operations of the air traffic controller, (2) reduce power consumption by airport regulators in the field, and (3) reduce training time. Results indicate that the mimic control and display system is very suitable for airport operations and that only economic considerations would be a determining factor in not using it. It is recommended that the system be used in any airport where multiple runways and taxiway paths exist, and also that a program be established to further determine any method that would reduce the cost of design and installation.
Author

**N76-16106#** Columbia Univ., New York. Plasma Lab.
**TIME DEPENDENT COMPUTER SIMULATION OF AN ELECTROMAGNETIC SHOCK TUBE**
C. K. Chu 1974 6 p refs Presented at the 7th Conf. on Numerical Simulation of Plasmas, New York, 2-4 Jun. 1975
(Contracts AT(11-1)-3086; AT(11-1)-2456)
(COO-2456-12; Conf-750606-6) Avail: NTIS HC $3.50

The high energy shock tube in the Columbia Plasma Physics Laboratory is an electromagnetically driven coaxial shock tube, designed to study shock-heated plasmas in regimes of fusion interest. The computational work devoted to this device is summarized. In order to (1) extend the theoretical understanding of the dynamics and physics of shock waves, particularly in more than one dimension, (2) anticipate and interpret experimental results, and (3) determine parameters in the design of some experiments.
NSA

**N76-16107#** Loughborough Univ. of Technology (England). Dept. of Transport Technology.
**PRELIMINARY DESIGN CHARTS FOR THE ASSESSMENT OF AIRPORT NOISE NUISANCE**
F. K. I. Hirji and D. M. Waters Nov. 1974 115 p refs
(TT-7412) Avail: NTIS HC $5.50

A preliminary design guide to assist planners, or cost benefit studies, in the initial siting of an airport relative to a city center is described. The U.S. Department Housing and Urban Development Noise Guidelines were used as the basis of a simple airport noise exposure model. Mean city population distributions, the percentage of population disturbed by aircraft noise, and an analysis of a number of social surveys provided the necessary population behavioral data. A computer program using a grid system assessed the number disturbed in each square and sums to give a total. The relatively crude model smooths out local variations and provides reasonable solutions for two test cases (Luton and Leeds/ Bradford). Total numbers disturbed are then presented for the average city of 900,000 population (central density 29,000 per sm) for three categories of airport against distance from city center and runaway alignment. The influence of variations of city size is also shown. Author (ESA)

**N76-16108#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
**MEASUREMENT OF VELOCITY PROFILES IN A SUPERSONIC WIND TUNNEL BY MEANS OF THE LASER DOPPLER METHOD [MESSUNG VON GESCHWINDIGKEITSPROFILEN IN EINEM UEBERSCHALLWINDKANAL MITTELS LASER-DOPPLER-VERFAHREN]**
Franz Maurer, Jens-Carsten Petersen, Hans Joachim Pfeiffer, and Jacques Haertig Bonn Bundesmin. fuer Forsch. und Technol. Sep. 1975 37 p refs In GERMAN; ENGLISH summary Prepared jointly with Inst. Franco-Allemand de Rech. de Saint-Louis
(Contracts BMFT-WRT-2073; GfW-RV-11-TP-17/72-B)
(BMFT-FB-W-75-15) Avail: NTIS HC $4.00; ZLDI, Munich DM 7,80

Mean velocity distributions and intensities of turbulence in the boundary layer of a 100 x 500 mm supersonic wind tunnel (M = 1.75 and 2.5) were determined, using a laser Doppler velocimeter. The measured values, reduced by means of a double counter method, were compared with those found elsewhere using a combined pressure and temperature probe. The values were in good correspondence and it is concluded that laser velocimetry is available as a noninterfering method for surveying supersonic flows.
ESA

**N76-16109#** Karlsruhe Univ. (West Germany). Inst. fuer Stroemungslehre und Stroemungsmaschinen.
**THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF OXYGEN DISSOCIATION RELAXATION BEHIND WEAK OBLIQUE SHOCKS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNG DER DISSOZIATIONSRELAXATION HINTER SCHWACHEN, SCHIEFEN STOESSEN IN SAUERSTOFF]**
Bernd Schmidt and Herbert Oertel, Jr. Bonn Bundesmin. fuer Forsch. und Technol. Sep. 1975 92 p refs In GERMAN; ENGLISH summary
(Contracts BMFT-RFT-1072; GfW-RV-11-TP-4/72-B)
(BMFT-FB-W-75-16) Avail: NTIS HC $5.00; ZLDI, Munich DM 19,35

In the detailed study presented, numerical calculations gave information about the length of the relaxation zone behind oblique shocks, and the range of experimental conditions allowing measurements in the dissociation relaxation zone could be estimated. The oblique shocks were photographed using a special double exposure procedure. The density profile in the relaxation zone behind the oblique shocks were measured with a multibeam laser-differentialinterferometer. The experiments confirmed the results of the calculation model. The best fit between model calculations and experimental results in the range from 3400 K to 4600 K was obtained using reaction rate coefficients established by Oertel, Jr.
Author (ESA)

**N76-16110#** Applied Science Associates, Inc., Valencia, Pa.
**SIMULATION DESIGN MANUAL FOR THE EC-2 SIMULATOR Final Report, Feb. 1974 - Feb. 1975**
William J. Pieper and Phillip G. Benson May 1975 51 p refs
(Contract F41609-73-C-0029; AF Proj. 1121)
(AD-A014798; AFHRL-TR-75-14) Avail: NTIS CSCL 05/9

This report can be used as an aid for developing simulation models (faceplate, slide disc visuals, and programs) for the EC-II programmable simulator. Guidance is provided for the design of the basic instructional program, including collection and organization of materials/information used to develop the model. Explanations are also provided for obtaining panel design data, developing program information, and developing program logic expressions.
GRA

**N76-16111#** Air Force Human Resources Lab., Brooks AFB, Tex.
**ASUPT (ADVANCED SIMULATION IN UNDERGRADUATE PILOT TRAINING) AUTOMATED OBJECTIVE PERFORMANCE MEASUREMENT SYSTEM Interim Report, Jul. 1973 - Jun. 1974**
Wayne L. Waag, Edward E. Eddowes, John H. Fuller, Jr., and Robert R. Fuller Mar. 1975 17 p ref
(AF Proj. 1123)
(AD-A014799; AFHRL-TR-75-3) Avail: NTIS CSCL 05/9

To realize its full research potential a need exists for the development of an automated objective pilot performance evaluation system for use in the Advanced Simulation in Undergraduate Pilot Training (ASUPT) facility. The present report documents the approach taken for the development of performance measures and also presents data collected from two preliminary evaluation studies. The results indicated that the objectively derived measures: (1) correlate highly with instructor ratings, and (2) discriminate between pilots of different experience levels. These findings are encouraging and demonstrate the potential of the present approach for generating the needed automated objective pilot performance measurement system.
GRA

**N76-16112#** Applied Science Associates, Inc., Valencia, Pa.
**OPERATIONAL TRYOUT OF A GENERAL PURPOSE SIMULATOR Final Report, Jun. 1974 - Jan. 1975**
Frank F. McGuirk, William J. Pieper, and Gary G. Miller Brooks AFB, Tex. AFHRL May 1975 51 p refs
(Contract F41609-73-C-0029; AF Proj. 1121)
(AD-A014794; AFHRL-TR-75-13) Avail: NTIS CSCL 05/9

The operational effectiveness of a general purpose simulator (GPS) was evaluated in a technical training course. GPS, in this context, refers to a computer based, programmable device that can be rather easily modified with varying levels of fidelity. A simulation model was designed for use in instructing students

in checkout and troubleshooting procedures for a sophisticated aircraft radar system. Evaluation results clearly showed that the stimulator was an effective training device: (a) training was at least as adequate as training received on an actual equipment trainer (AET) used in the course, (b) the simulator was much less expensive and more reliable than the AET, and (c) the simulator had the additional capability of training troubleshooting tasks. GRA

**N76-16113#** Utah State Univ., Logan. Coll. of Engineering.
**MODEL STUDY OF C-5A LANDINGS ON DOW TRUSS WEB LANDING MAT Final Report, 28 Jun. 1973 - 28 Mar. 1975**
Fred W. Kiefer, Paul T. Blotter, and Vance T. Christiansen Aug. 1975 97 p refs
(Contract F29601-73-C-0131; AF Proj. 683M; DA Proj. 1T1-62112-A-131)
(AD-A015021; AEWES-CR-S-75-3) Avail: NTIS CSCL 01/5

A series of model C-5A landing tests on 4 by 4.5 ft. and 2 by 9 ft. Dow truss web landing mat runways were studied using a 1/7 scale physical model. Model landing mat units were constructed of extruded aluminum joint edges bonded to a foam core fiber glass panel. Simulated landings were made on 14.5 by 128 ft. mat runways. The model 4 by 4.5 ft. mats were tested in four runway laying patterns. Laying patterns without a transverse hinged joint formed the most stable runway. When laid in the standard brick pattern with a transverse hinged joint, the 4 by 4.5 ft. mat runway was more stable than the 2 by 9 ft. mat runway. The 2 by 9 ft. mat runways were tested only in the standard brick pattern. Restraint at the runway edge did not prevent buckling of the 2 by 9 ft. mat runway in the standard brick pattern. Tension anchors at the touchdown end of the runway controlled th3 longitudinal displacement and prevented buckling of both mat types when laid in the standard brick pattern. The use of end anchorage appears to be a practical method to reduce mat runway maintenance and prevent buckling failure. Author (GRA)

**N76-16114#** General Dynamics/Convair, San Diego, Calif.
**STUDY OF MULTIPIECE, FLOW-THROUGH WIND TUNNEL MODELS FOR HIRT Final Report, Apr. - Dec. 1973**
W. K. Alexander, S. A. Griffin, and A. E. Brady Nov. 1975 92 p refs
(Contract F40600-72-C-0015)
(AD-A017286; CASD-AFS-73-006; AEDC-TR-75-60) Avail: NTIS CSCL 14/2

The usefulness of the proposed High Reynolds Number Transonic Wind Tunnel (HIRT) of AEDC will be largely influenced by the restrictions placed on testing due to model limitations. A preliminary study of models determined that basic models (without internal airflow) could be designed and tested in HIRT with few restrictions. The present study contains a more detailed analysis of the limitations of a high-performance fighter aircraft model, with variables similar to those for present-day transonic wind tunnels. A typical test plan is outlined, and model, balance, and support system limitations are presented. GRA

# 12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**N76-16115#** Joint Publications Research Service, Arlington, Va.
**CONTROL OF BALLISTIC MISSILES AND SPACECRAFT**
A. M. Zhakov 12 Dec. 1975 101 p Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 38-84, 136-182 (JPRS-66356) Avail: NTIS HC $5.50

Trajectory and angular motion control of ballistic missiles and spacecraft. For individual titles, see N76-16116 through N76-16121.

**N76-16116** Joint Publications Research Service, Arlington, Va.
**CHARACTERISTICS OF THE TRAJECTORY OF BALLISTIC MISSILES**
*In its* Control of Ballistic Missiles and Spacecraft (JPRS-66356) 12 Dec. 1975 p 1-10 Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 38-48 (For availability see N76-16115 07-12)

Elliptical trajectories, intersecting with the earth's surface at the target, are characteristic of ballistic missiles. The characteristics of the trajectories -- flight range, flight time, altitude of missile ascent on the passive segment etcetera -- are determined by the parameters of the motion of the missile at the ground point. Author

**N76-16117** Joint Publications Research Service, Arlington, Va.
**ACCURACY OF HITTING A TARGET**
*In its* Control of Ballistic Missiles and Spacecraft (JPRS-66356) 12 Dec. 1975 p 12-35 Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 49-71 (For availability see N76-16115 07-12)

Computation of the trajectories of ballistic missiles on the assumption that the earth is an ideal sphere and possesses a central field of gravity is capable of giving only approximate coordinates of the point of incidence. The formulas and graphs given are intended only for approximate computations. Precise computations made for military usage of missiles require the introduction of many corrections, by allowance for which the complexity of investigating the movement of a missile and determining its trajectory is increased many fold. Author

**N76-16118** Joint Publications Research Service, Arlington, Va.
**SCATTERING OF BALLISTIC MISSILES**
*In its* Control of Ballistic Missiles and Spacecraft (JPRS-66356) 12 Dec. 1975 p 36-42 Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 72-78 (For availability see N76-16115 07-12)

The probability of a missile hitting a target is computed by considering target dimensions, missile scattering characteristics, warhead strike zone radius, and missile trajectory control errors. G.G.

**N76-16119** Joint Publications Research Service, Arlington, Va.
**PROBLEMS OF CONTROLLING THE FLIGHT OF A BALLISTIC MISSILE**
*In its* Control of Ballistic Missiles and Spacecraft (JPRS-66356) 12 Dec. 1975 p 43-48 Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 79-83 (For availability see N76-16115 07-12)

Flight control of a ballistic missile is divided into two specific problems: control of the flight range, and control of the lateral movement. Flight range control provides the first condition of hitting the target, control of the lateral motion satisfies the second condition. Author

**N76-16120** Joint Publications Research Service, Arlington, Va.
**CONTROLLING MOTION AROUND THE CENTER OF GRAVITY**
*In its* Control of Ballistic Missiles and Spacecraft (JPRS-66356) 12 Dec. 1975 p 49-70 Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 136-157 (For availability see N76-16115 07-12)

Control of the angular motion of a missile is accomplished with the aid of automatic equipment for angular stabilization. To do this, the deviations in the angles of yawing, pitching and banking from their programmed values are measured. The programmed values of the angles of banking and yawing are equal to zero, and the law of change in the angle of pitching is determined by the programmed path of the missile on the trajectory of free flight. Upon the occurence of errors, the automatic equipment for stabilization shapes signals for deflection of the rudders in order to maintain the given position of the missile's axes in space. Author

**N76-16121** Joint Publications Research Service, Arlington, Va.
**CONTROLLING THE MOTION OF THE CENTER OF GRAVITY**

*In its* Control of Ballistic Missiles and Spacecraft (JPRS-66356) 12 Dec. 1975 p 71-97 Transl. into ENGLISH from the book "Upravleniye ballisticheskimi raketami i kosmicheskimi obyektami" Moscow, 5 Aug. 1974 p 158-182 (For availability see N76-16115 07-12)

A typical sequence of operations carried out during orbital correction for missile or spacecraft control requires the aid of automatic angular stabilization equipment and supplemental correction of lateral deflections from the aiming plane. For this it is necessary to measure the coordinates of the center of gravity of the missile and control the changes in these coordinates. Control of the lateral motion of the center of gravity is accomplished by changing of the course. The signal which depends on lateral deflection is introduced into the automatic angular stabilization equipment. Elimination of lateral displacement from the aiming plane is accomplished by rudder agitation. Author

# 13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

**N76-16122*#** Battelle Columbus Labs., Ohio.
**STUDY OF GROWTH OF SINGLE CRYSTAL RIBBON IN SPACE Final Report, 3 Sep. 1974 - 23 Oct. 1975**
Van E. Wood and Alan J. Markworth 30 Oct. 1975 107 p refs
(Contract NAS8-31007)
(NASA-CR-144135) Avail: NTIS HC $5.50 CSCL 20B

The technical feasibility is studied of growing single-crystal silicon ribbon in the space environment. Procedures are described for calculating the electromagnetic fields produced in a silicon ribbon by an rf shaping coil. The forces on the ribbon and the degree of shaping to be expected are determined. The expected steady-state temperature distribution in the ribbon is calculated in the one-dimensional approximation. Calculations on simplified models indicate, that lack of flatness of the shaped ribbon and excessive heating of the melt by the eddy currents induced by the shaping fields may pose problems. An analysis of the relative effects of various kinds of forces other than electromagnetic showed that in the space environment capillarity forces would dominate, and that the shape of the melt is thus principally determined by the shape of any solids with which it comes in contact. This suggests that ribbon may be produced simply by drawing between parallel wires. A concept is developed for a process of off-angle growth, in which the ribbon is pulled at an angle to the solidification front. Such a process promises to offer increased growth rate, better homogeneity, and thinner ribbon. Author

**N76-16123#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**SALYUT-4: APPARATUS AND POSSIBILITIES**
M. Kasimova 1975 5 p Transl. into ENGLISH from Aviat. Kosmonavt. (USSR), no. 7, 1975 p 26-27
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

The docking technique of Soyuz-17 and Salyut-4 is described along with the interior of the orbiting space station. The transfer compartment, scientific-apparatus compartment, control panels, sleeping quarters, eating area, and the space stadium are included. J.M.S.

**N76-16124#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**METHODS OF RAISING THE EFFICIENCY OF USING ASTRO-MEASURING SPACE NAVIGATION FACILITIES**
A. G. Nikolaev, N. F. Romanteev, V. I. Sevastianov, and A. V. Levitskii 1975 9 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. 12, no. 4, 1975 p 595-602
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

Results of experimental investigations of the accuracy characteristics of astro-measuring instruments of autonomous space navigation are presented. Methods are proposed to raise the accuracy of astronomical methods of manned spacecraft navigation. Author

**N76-16125*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**SPACELAB MISSION DEPENDENT TRAINING PARAMETRIC RESOURCE REQUIREMENTS STUDY**
Dester H. Ogden (M and S Computing, Inc.), Harry Watters, Jackie Steadman, and Lora Conrad (PRC Systems Services Co.) Jan. 1976 85 p refs
(NASA-TM-X-64979) Avail: NTIS HC $5.00 CSCL 05I

Training flows were developed for typical missions, resource relationships analyzed, and scheduling optimization algorithms defined. Parametric analyses were performed to study the effect of potential changes in mission model, mission complexity and training time required on the resource quantities required to support training of payload or mission specialists. Typical results of these analyses are presented both in graphic and tabular form. Author

**N76-16126*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.
**MOTION EQUATIONS OF A SATELLITE AROUND THE CENTER OF MASS**
V. A. Sarychev and N. I. Yakovlev Washington NASA Jan. 1976 50 p refs Transl. into ENGLISH from "O Uravneniyakh Dvizheniya Sputnika Okolo Tsentrah Mass" Preprint-55, Moscow, 1975 52 p
(Contract NASw-2789)
(NASA-TT-F-16830; Preprint-55) Avail: NTIS HC $4.00 CSCL 22A

Motion equations of a satellite around the center of mass with different damping devices were obtained. The matrix form for recording Euler-Lagrange equations in quasi-coordinates are applied. Necessary and sufficient conditions of asymptotic stability for stationary solution of these equations were found. Author

# 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

**N76-16127*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SPACELAB SIMULATION USING A LEAR JET AIRCRAFT: MISSION NO. 4 (ASSESS PROGRAM)**
John O. Reller, Jr., Carr B. Neel, and Robert H. Mason Oct. 1975 158 p refs
(NASA-TM-X-62474; A-6245) Avail: NTIS HC $6.75 CSCL 22A

The fourth ASSESS Spacelab simulation mission utilizing a Lear Jet aircraft featured trained experiment operators (EOs) in place of the participating scientists, to simulate the role and functions of payload specialists in Spacelab who may conduct experiments developed by other scientists. The experiment was a broadband infrared photometer coupled to a 30-cm, open port, IR telescope. No compromises in equipment design or target selection were made to simplify operator tasks; the science goals of the mission were selected to advance the mainline research program of the principle investigator (PI). Training of the EOs was the responsibility of the PI team and consisted of laboratory sessions, on-site training during experiment integration, and integrated mission training using the aircraft as a high-fidelity simulator. The EO permission experience in these several disciplines proved adequate for normal experiment operations, but marginal for the identification and remedy of equipment malfunctions. During the mission, the PI utilized a TV communication system to assist the EOs to overcome equipment difficulties; both science and operations were successfully implemented. Author

# 15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

**N76-16128*#** General Electric Co., Philadelphia, Pa. Space Div.
**LANDSAT-1 AND LANDSAT-2 FLIGHT EVALUATION Technical Report, 23 Apr. - 23 Jul. 1975**
10 Oct. 1975 215 p refs
(Contract NAS5-21808)
(NASA-CR-144711; Doc-75SDS4255) Avail: NTIS HC $7.75 CSCL 22C

The flight performance of Landsat 1 and Landsat 2 is analyzed. Flight operations of the satellites are briefly summarized. Other topics discussed include: orbital parameters; power subsystem; attitude control subsystem; command/clock subsystem; telemetry subsystem; orbit adjust subsystem; magnetic moment compensating assembly; unified s-band/premodulation processor; electrical interface subsystem; thermal subsystem; narrowband tape recorders; wideband telemetry subsystem; attitude measurement sensor; wideband video tape recorders; return beam vidicon; multispectral scanner subsystem; and data collection subsystem. J.M.S.

# 16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

No abstracts in this category.

# 17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

**N76-16129*#** Hughes Aircraft Co., El Segundo, Calif. Space and Communications Group.
**TECHNOLOGY FORECASTING FOR SPACE COMMUNICATION. TASK ONE REPORT: COST AND WEIGHT TRADEOFF STUDIES FOR EOS AND TDRS**
Nov. 1974 108 p refs
(Contract NAS5-22178)
(NASA-CR-144713) Avail: NTIS HC $5.50 CSCL 17B

Weight and cost optimized EOS communication links are determined for 2.25, 7.25, 14.5, 21, and 60 GHz systems and for a 10.6 micron homodyne detection laser system. EOS to ground links are examined for 556, 834, and 1112 km EOS orbits, with ground terminals at the Network Test and Tracking Facility and at Goldstone. Optimized 21 GHz and 10.6 micron links are also examined. For the EOS to Tracking and Data Relay Satellite to ground link, signal-to-noise ratios of the uplink and downlink are also optimized for minimum overall cost or spaceborne weight. Finally, the optimized 21 GHz EOS to ground link is determined for various precipitation rates. All system performance parameters and mission dependent constraints are presented, as are the system cost and weight functional dependencies. The features and capabilities of the computer program to perform the foregoing analyses are described. Author

**N76-16130*#** Scientific Translation Service, Santa Barbara, Calif.
**INTERNATIONAL COOPERATION IN THE ESTABLISHMENT AND OPERATION OF A GLOBAL SATELLITE COMMUNICATIONS SYSTEM**
E. Dietrich Washington NASA Jan. 1976 14 p Transl. into ENGLISH from Nachrichtentech. Fachber. (West Ger.), v. 32, 1967 p 1-5
(Contract NASw-2791)
(NASA-TT-F-16835) Avail: NTIS HC $3.50 CSCL 17B

International cooperation with regard to telecommunications satellites is discussed. The role of the National Aeronautics and Space Administration in this cooperation is analyzed. Author

**N76-16131#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**UHF SATELLITE COMMUNICATION DURING SCINTILLATION**
Edward A. Bucher 5 Aug. 1975 104 p refs
(Contract F19628-76-C-0002; AF Proj. 3279)
(AD-A014801; TN-1975-10; ESD-TR-75-242) Avail: NTIS CSCL 17/2

The effects of ionospheric UHF scintillation on satellite communications are described in terms of relatively simple fading channel models. Two methods of countering the effects of scintillation induced fading on satellite communications are presented and analyzed. First, threshold testing techniques which effectively erase faded data are discussed. These techniques are most easily applied to add scintillation protection to an operating communication system which handles segments or blocks of data. Second, time diversity modulation techniques which can counter scintillation and other channel problems such as RFI and excess noise in the same operation are discussed. These time diversity modulation techniques offer somewhat better performance than the threshold techniques at the cost of a somewhat more complex interface between the basic receiver and the anti-scintillation processor. GRA

# 18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

**N76-16132*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF AN INVESTIGATION OF THE 0.003-SCALE SPACE SHUTTLE EXTERNAL TANK MSFC MODEL 460 IN THE NASA/MSFC 14 X 14-INCH TRISONIC WIND TUNNEL TO DETERMINE STATIC PRESSURE DISTRIBUTIONS DURING REENTRY (TA2F), VOLUME 1**
P. E. Ramsey (NASA. Marshall Space Flight Center) and G. W. Winkler (Northrop Services, Inc., Huntsville, Ala.) Nov. 1975 771 p
(Contract NAS9-13247)
(NASA-CR-141823; DMS-DR-2165-Vol-1) Avail: NTIS HC $18.75 CSCL 22B

Objectives of the test were to obtain static pressure distributions for the ET at reentry conditions. Basic configuration of the model was the MCR 0200 ET modified to include a rectangular crossbar at the aft ET/orbiter attach point. Mach numbers were 1.96, 3.48, and 4.96. Reynolds number per foot at these Mach numbers were 6.95 million, 6.42 million, and 4.95 million, respectively. Angle of attack range was -8 to 100 degrees and roll angle was 0 to 315 degrees. Occupancy hours were 104. Author

**N76-16133*#** Chrysler Corp., New Orleans, La. Data Management Services.
**RESULTS OF AN INVESTIGATION OF THE 0.003-SCALE SPACE SHUTTLE EXTERNAL TANK MSFC MODEL 460 IN THE NASA/MSFC 14 X 14-INCH TRISONIC WIND TUNNEL TO DETERMINE STATIC PRESSURE DISTRIBUTIONS DURING REENTRY (TA2F), VOLUME 2**

P. E. Ramsey (NASA. Marshall Space Flight Center, Huntsville, Ala.) and G. W. Winkler (Northrop Serv., Inc., Huntsville, Ala.) Nov. 1975 535 p refs
(Contract NAS9-13247)
(NASA-CR-141824; DMS-DR-2165-Vol-2) Avail: NTIS HC $13.00 CSCL 22B
For abstract, see N76-16132.

**N76-16134*#** Chrysler Corp., New Orleans, La. Data Management Services.
**RESULTS OF AN INVESTIGATION OF THE 0.003-SCALE SPACE SHUTTLE EXTERNAL TANK MSFC MODEL 460 IN THE NASA/MSFC 14 X 14-INCH TRISONIC WIND TUNNEL TO DETERMINE STATIC PRESSURE DISTRIBUTIONS DURING REENTRY (TA2F), VOLUME 5**
P. E. Ramsey (NASA. Marshall Space Flight Center, Huntsville, Ala.) and G. W. Winkler (Northrop Serv., Inc., Huntsville, Ala.) Nov. 1975 256 p refs
(Contract NAS9-13247)
(NASA-CR-141827; DMS-DR-2165-Vol-5) Avail: NTIS HC $9.00 CSCL 22B
For abstract, see N76-16132.

**N76-16135*#** Chrysler Corp., New Orleans, La. Data Management Services.
**RESULTS OF AN INVESTIGATION OF THE 0.003-SCALE SPACE SHUTTLE EXTERNAL TANK MSFC MODEL 460 IN NASA/MSFC 14 X 14-INCH TRISONIC WIND TUNNEL TO DETERMINE STATIC PRESSURE DISTRIBUTIONS DURING REENTRY (TA2F), VOLUME 4**
P. E. Ramsey (NASA. Marshall Space Flight Center, Huntsville, Ala.) and G. W. Winkler (Northrop Serv., Inc., Huntsville, Ala.) Nov. 1975 795 p refs
(Contract NAS9-13247)
(NASA-CR-141826; DMS-DR-2165-Vol-4) Avail: NTIS HC $18.75 CSCL 22B
For abstract, see N76-16132.

**N76-16136*#** Chrysler Corp., New Orleans, La. Space Div.
**AN INVESTIGATION IN THE MSFC TWT TO DETERMINE SPOILER EFFECTS ON WING LOADS AND ELEVON HINGE MOMENTS UTILIZING 0.004-SCALE MODELS (77-0 AND 74-OTS) OF THE SHUTTLE VEHICLE 5 CONFIGURATION (IA125) Aerothermodynamic Data Report**
E. C. Allen (Rockwell Intern., Huntsville, Ala.) 30 Jan. 1976 778 p
(Contract NAS9-13247)
(NASA-CR-141833; DMS-DR-2253) Avail: NTIS HC $18.75 CSCL 22B

Information is presented for wind tunnel tests (IA125) of a 0.004-scale orbiter, external tank, and solid rocket motor integrated vehicle model (77-0 and 74-OTS) in the MSFC Trisonic Wind Tunnel. These tests were conducted in support of MCR's 1344 and 1346. Data from these tests provide spoiler effects on wing bending/torsion and elevon hinge moments, elevon effectiveness data and the influence of solid plumes from Mach numbers of 0.6 through 2.74 at angles of attack and sideslip from -10 through 10 degrees. Author

**N76-16137*#** Chrysler Corp., New Orleans, La. Space Div.
**LANDING PRESSURE LOADS OF THE 140A/B SPACE SHUTTLE ORBITER (MODEL 43-0) DETERMINED IN THE ROCKWELL INTERNATIONAL LOW SPEED WIND TUNNEL (OA69), VOLUME 1 Aerothermodynamic Data Report**
T. L. Soard (Rockwell Intern. Corp., Los Angeles) Dec. 1975 506 p refs 2 Vol.
(Contract NAS9-13247)
(NASA-CR-144580; DMS-DR-2081-Vol-1) Avail: NTIS HC $12.75 CSCL 22B

Wind tunnel tests of a 0.0405 scale model of the -1404A/B configuration of the Space Shuttle Vehicle Orbiter are presented. Pressure loads data were obtained from the orbiter in the landing configuration in the presence of the ground for structural strength analysis. This was accomplished by locating as many as 30 static pressure bugs at various locations on external model surfaces as each configuration was tested. A complete pressure loads survey was generated for each configuration by combining data from all bug locations, and these loads are described for the fuselage, wing, vertical tail, and landing gear doors. Aerodynamic force data was measured by a six component internal strain gage balance. This data was recorded to correct model angles of attack and sideslip for sting and balance deflections and to determine the aerodynamic effects of landing gear extension. All testing was conducted at a Mach number of 0.165 and a Reynolds number of 1.2 million per foot. Photographs of test configurations are shown. Author

**N76-16138*#** Chrysler Corp., New Orleans, La. Space Div.
**LANDING PRESSURE LOADS OF THE 140A/B SPACE SHUTTLE ORBITER (MODEL 43-0) DETERMINED IN THE ROCKWELL INTERNATIONAL LOW SPEED WIND TUNNEL (OA69), VOLUME 2 Aerothermodynamic Data Report**
T. L. Soard (Rockwell Intern. Corp., Los Angeles) Dec. 1975 473 p 2 Vol.
(Contract NAS9-13247)
(NASA-CR-144581; DMS-DR-2081-Vol-2) Avail: NTIS HC $12.00 CSCL 22B
For abstract, see N76-16137.

**N76-16139*#** Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
**SPACE SHUTTLE RUDDER/SPEEDBRAKE SUBSYSTEM ANALYSIS**
H. G. Duke Sep. 1975 160 p refs
(Contract NAS9-12200)
(NASA-CR-147415; LEC-6730; JSC-09940) Avail: NTIS HC $6.75 CSCL 22B

The Continuous System Modeling Program (CSMP) is described with its uses, its limitations, and its application to the rudder/speedbrake (R/SB) subsystem. The space shuttle R/SB is analyzed using the CSMP. Areas of analysis emphasized include: step response, ramp response, and the delay time or deadspace observed in system response. Results are presented and discussed. J.M.S.

**N76-16140*#** Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
**DEVELOPMENT OF AN ACTUATOR SIMULATOR CONSOLE FOR THE SPACE SHUTTLE ELEVON SUBSYSTEM**
G. C. Streuding Nov. 1975 35 p refs
(Contract NAS9-12200)
(NASA-CR-147414; LEC-7181) Avail: NTIS HC $4.00 CSCL 22B

The development, design, construction, and testing of an elevon simulator console (ASC) are discussed. The ASC is an electronic analog of the elevon hydraulic servoactuator subsystem to be used in the space shuttle flight control system. Author

**N76-16141*#** Chrysler Corp., New Orleans, La.
**HEAT TRANSFER TESTS ON A 0.01-SCALE ROCKWELL CONFIGURATION 3 SPACE SHUTTLE ORBITER AND TANK (37-OT) IN THE CALSPAN 48-INCH HYPERSONIC SHOCK TUNNEL (OH12/IH21), VOLUME 1**
M. Kotch (Rockwell Intern., Downey, Calif.) Oct. 1975 444 p refs
(Contract NAS9-13247)
(NASA-CR-141828; DMS-DR-2164-Vol-1) Avail: NTIS HC $11.75 CSCL 22B

Model information and data are presented from wind tunnel tests conducted on 0.01-scale models of the space shuttle orbiter and external tank. These tests were conducted in a hypersonic shock tunnel to determine heating rates on ascent and reentry configurations at various Reynolds numbers, Mach numbers, and angles of attack. Author

**N76-16142*#** Chrysler Corp., New Orleans, La.
**HEAT TRANSFER TESTS ON A 0.01-SCALE ROCKWELL CONFIGURATION 3 SPACE SHUTTLE ORBITER AND TANK (37-OT) IN THE CALSPAN 48-INCH HYPERSONIC SHOCK TUNNEL (OH12/IH21), VOLUME 2**
M. Kotch (Rockwell Intern., Downey, Calif.) Oct. 1975 684 p refs
(Contract NAS9-13247)
(NASA-CR-141829; DMS-DR-2164-Vol-2) Avail: NTIS HC $16.25 CSCL 22B

Data figures are presented for wind tunnel tests conducted

on scale models of the space shuttle orbiter and external tank.
Author

**N76-16143*#** Chrysler Corp., New Orleans, La.
**HEAT TRANSFER TESTS ON A 0.01-SCALE ROCKWELL CONFIGURATION 3 SPACE SHUTTLE ORBITER AND TANK (37-OT) IN THE CALSPAN 48-INCH HYPERSONIC SHOCK TUNNEL (OH12/IH21), VOLUME 3**
M. Kotch (Rockwell Intern., Downey, Calif.) Oct. 1975 494 p refs
(Contract NAS9-13247)
(NASA-CR-141830; DMS-DR-2164-Vol-3) Avail: NTIS HC $11.75 CSCL 22B

Tabulated source data are presented for wind tunnel tests conducted on scale models of the space shuttle orbiter and external tank. Author

**N76-16144*#** Chrysler Corp., New Orleans, La. Space Div.
**AN INVESTIGATION OF THE 0.0091 SCALE EXTERNAL TANK OGIVE NOSE (MSFC MODEL 470) IN THE MSFC 14 INCH TWT TO DETERMINE THE PRESSURE DISTRIBUTION AROUND THE EXTERNAL TANK NOSE (TA3F), VOLUME 1**
Paul E. Ramsey, G. W. Winkler (Northrop Serv., Inc., Huntsville, Ala.), and T. C. Davis (Northrop Serv., Inc., Huntsville, Ala.) Dec. 1975 520 p refs
(Contract NAS9-13247)
(NASA-CR-144590; DMS-DR-2208-Vol-1) Avail: NTIS HC $12.75 CSCL 22B

The model tested was a 0.0091 scale representation of the ogive nose section of the External Tank with nose cap and lightning rod and protuberances. Pressure distribution around the nose cap was determined. Pressure data were also obtained along the ogive nose. Data were obtained over an angle of attack range of + or -5 degrees and over a Mach number range of .6 to 4.96. The Reynolds number per unit length (ft.) ranged from 4.1 million to 4.96 million. There were 22 pressure ports in a single row. Circumferential positions of 0, 22.5, 45, 67.5 and 90 degrees were simulated by rotating the model. The LO2 feed line and LO2 recirculation line were simulated. The effects of the nose spike were investigated over a range of Mach numbers. The data will be useful for venting analyses. Photographs showing flow visualization of the test configuration are given. Author

**N76-16145*#** Chrysler Corp., New Orleans, La. Space Div.
**AN INVESTIGATION OF THE 0.0091 SCALE EXTERNAL TANK OGIVE NOSE (MSFC MODEL 470) IN THE MSFC 14 INCH TWT TO DETERMINE THE PRESSURE DISTRIBUTION AROUND THE EXTERNAL TANK NOSE (TA3F), VOLUME 2**
Paul E. Ramsey, G. W. Winkler (Northrop Serv., Inc., Huntsville, Ala.), and T. C. Davis (Northrop Serv., Inc., Huntsville, Ala.) Dec. 1975 646 p refs
(Contract NAS9-13247)
(NASA-CR-144591; DMS-DR-2208-Vol-2) Avail: NTIS HC $16.25 CSCL 22B

For abstract, see N76-16144.

**N76-16146*#** Gill (M. C.) Corp., El Monte, Calif.
**INTEGRALLY RIGIDIZED ACOUSTIC INTERIOR SPACECRAFT PANEL**
9 Jan. 1976 12 p
(NASA Order T-1743-D)
(NASA-CR-147429) Avail: NTIS HC $3.50 CSCL 22A

A sandwich panel concept is described which utilizes a monolithic I-beam design as the core. The core and skins are integrally bonded with thermosetting resin into a homogeneous structure. In addition to possessing a high strength to weight ratio, the panel resists combustion, delamination, aging due to fatigue, localized stresses, and exhibits good acoustic properties. Since the panel concept has definite potential as a high flame retardant and low smoke emission panel with excellent structural integrity, aerospace materials were used to optimize the construction for highly demanding space shuttle applications. The specific materials of construction were chosen for low flammability and off-gassing properties as well as for strength, light weight, and sound dampening. Author

**N76-16147*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF AN INVESTIGATION OF HYPERSONIC VISCOUS INTERACTION EFFECTS OF THE SPACE SHUTTLE ORBITER USING A 0.010 SCALE MODEL (51-0) IN THE AEDC-VKF TUNNEL F (OA160)**
D. J. Elder (Rockwell Intern. Space Div., Downey, Calif.) Dec. 1975 94 p refs
(Contract NAS9-13247)
(NASA-CR-141834; DMS-DR-2247) Avail: NTIS HC $5.00 CSCL 22A

An experimental aerodynamic investigation was conducted in the AEDC-VKF Hypervelocity Wind Tunnel (Tunnel F) at a nomial Mach number of 19 to determine hypersonic viscous interaction effects on the space shuttle orbiter. The tests were conducted at an angle of attack of 30 degrees over a free-stream Reynolds number (based on fuselage length) variation from 0.1 to 0.4 million. Viscous interaction parameter was varied from 0.02 to 0.06. Six component static stability force and moment data were measured by an internally compensated internal strain gage balance. Resulting data are presented. Author

**N76-16148*#** Chrysler Corp., New Orleans, La. Space Div.
**HEAT TRANSFER TESTS OF AN 0.006-SCALE THIN-SKIN SPACE SHUTTLE THERMOCOUPLE MODEL (141-OT) IN THE LANGLEY RESEARCH CENTER FREON TUNNEL AT M-6 (IH18) Aerothermodynamic Data Report**
D. G. Walstad (Rockwell Intern. Corp., Downey, Calif.) Jan. 1976 627 p
(Contract NAS9-13247)
(NASA-CR-144589; DMS-DR-2110) Avail: NTIS HC $16.25 CSCL 22C

Ascent heating data were obtained at conditions simulating real gas effects at hypersonic Mach numbers. The configurations tested were Orbiter alone, external tank alone, and mated Orbiter and external tank. A boundary layer trip investigation was conducted for all configurations. The test was conducted at Mach 6 and Reynolds number of one half million per foot for 0 deg and -5 deg angle-of-attack. Selected thermocouples were chosen from the Orbiter and external tank to be used for obtaining heat transfer measurements. A maximum of 42 thermocouples could be measured by the facility data acquisition at one time and no attempt was made to record the excess thermocouples located on the model. Photographs of the test configurations are shown. Author

**N76-16149*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF AN INVESTIGATION OF HYPERSONIC VISCOUS INTERACTION EFFECTS ON AND 0.01 SCALE SPACE SHUTTLE ORBITER 51-0 MODEL IN THE AEDC-VKF HYPERVELOCITY WIND TUNNEL (0A81)**
D. J. Elder (Rockwell Intern. Corp., Downey, Calif.) Dec. 1975 113 p refs Revised
(Contract NAS9-13247)
(NASA-CR-134423; DMS-DR-2152-Rev-A) Avail: NTIS HC $5.50 CSCL 22A

The major hypersonic aerodynamic results obtained experimentally from the 0.010-scale (51-0) 140A/B orbiter vehicle are presented. The test was conducted over an angle-of-attack range from 20 to 35 degrees for nominal Mach numbers of 16 and 20. The Mach 16 data were obtained at Reynolds numbers, based on model length, of nominally 0.54 x 106 and 1.18 x 106. The Mach number 20 data were obtained at nominal Reynolds numbers of 0.08 x 106 and 0.27 x 106. Various elevon deflections and body flap deflections were tested for determination of control effectiveness. The test objectives were: (1) verify December 1973 aerodynamic Design Data Book estimates for Mach number greater than 10; (2) determine configuration forward and aft trim boundaries and control characteristics; (3) determine high Mach number - low Reynolds number effects; (4) determine if positive control surface flow separation is present and magnitude of separation effects.
Author

**N76-16150*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF AN AERODYNAMIC INVESTIGATION OF A SPACE SHUTTLE ORBITER/747 CARRIER VEHICLE CONFIGURATION TO ESTABLISH A FREE-STREAM DATA BASE FOR ALT SEPARATION INVESTIGATIONS, UTILIZING**

**A 0.0125-SCALE MODEL (48-0/AX1318I-1) IN THE ARC 14-FOOT WIND TUNNEL (CA23A)**
R. L. Gillins (Rockwell Intern. Corp., Downey, Calif.) Dec. 1975 626 p refs
(Contract NAS9-13247)
(NASA-CR-144583; DMS-DR-2243) Avail: NTIS HC $16.25 CSCL 22A

Force and moment data are presented which were obtained for each vehicle separately at a Mach number of 0.6, and for the mated orbiter/747 configuration at Mach numbers of 0.3, 0.5, 0.6, and 0.7. Orbiter angles of attack from 0 degrees to +12 degrees and 747/Carrier angles of attack from -3 degrees to +7 degrees were investigated at angles of sideslip of 0 degrees and -5 degrees. Model variables include orbiter elevon and rudder deflections, orbiter tail cone-on and off, various orbiter/747 attach structure configurations, 747 stabilizer and rudder deflections, and 747 CAM modification components-on and off. Photographs of test configurations are included. Author

**N76-16151*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF TESTS USING A 0.030-SCALE MODEL (45-0) OF SPACE SHUTTLE VEHICLE ORBITER IN THE NASA/ARC 12-FOOT PRESSURE WIND TUNNEL (OA159) Aerothermodynamic Data Report**
J. Marroquin (Rockwell Intern. Corp., Downey, Calif.) Nov. 1975 176 p refs
(Contract NAS9-13247)
(NASA-CR-141832; DMS-DR-2265) Avail: NTIS HC $7.50 CSCL 22A

An experimental investigation (test OA159) was conducted in the NASA/ARC 12-foot Pressure Wind Tunnel from June 23 through July 8, 1975. The objective was to obtain detailed strut tare and interference effects of the support system used in the NASA/ARC 40 x 80-foot wind tunnel during 0.36-scale orbiter testing (OA100). Six-component force and moment data were obtained through an angle-of-attack range from -9 through +18 degrees with 0 deg angle of sideslip and a sideslip angle range from -9 through +18 degrees at 9 deg angle of attack results are presented. Author

**N76-16152*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF PRESSURE DISTRIBUTION TESTS OF A 0.010-SCALE SPACE SHUTTLE ORBITER MODEL (61-0) IN THE NASA/ARC 3.5-FOOT HYPERSONIC WIND TUNNEL (TEST OH38), VOLUME 1**
W. H. Dye (Rockwell Intern. Corp., Downey, Calif.) and T. Polek (NASA. Ames Res. Center) Dec. 1975 652 p 3 Vol.
(Contract NAS9-13247)
(NASA-CR-144584-Vol-1; DMS-DR-2171-Vol-1) Avail: NTIS HC $16.25 CSCL 22A

Test results are presented of hypersonic pressure distributions at simulated atmospheric entry conditions. Pressure data were obtained at Mach numbers of 7.4 and 10.4 and Reynolds numbers of 3.0 and 6.5 million per foot. Data are presented in both plotted and tabulated data form. Photographs of wind tunnel apparatus and test configurations are provided. Author

**N76-16153*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF PRESSURE DISTRIBUTION TESTS OF A 0.010-SCALE SPACE SHUTTLE ORBITER MODEL (61-0) IN THE NASA/ARC 3.5-FOOT HYPERSONIC WIND TUNNEL (TEST OH38), VOLUME 2**
W. H. Dye (Rockwell Intern. Corp., Downey, Calif.) and T. Polek (NASA. Ames Res. Center) Dec. 1975 780 p 3 Vol.
(Contract NAS9-13247)
(NASA-CR-144584-Vol-2; DMS-DR-2171-Vol-2) Avail: NTIS HC $18.75 CSCL 22A
For abstract, see N76-16152.

**N76-16154*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF PRESSURE DISTRIBUTION TESTS OF A 0.010-SCALE SPACE SHUTTLE ORBITER MODEL (61-0) IN THE NASA/ARC 3.5-FOOT HYPERSONIC WIND TUNNEL (TEST OH38), VOLUME 3**
W. H. Dye (Rockwell Intern. Corp. Downey, Calif.) and T. Polek (NASA. Ames Res. Center) Dec. 1975 674 p 3 Vol.
(Contract NAS9-13247)
(NASA-CR-144584-Vol-3; DMS-DR-2171-Vol-3) Avail: NTIS HC $16.25 CSCL 22A
For abstract, see N76-16152.

**N76-16155*#** Chrysler Corp., New Orleans, La. Space Div.
**RESULTS OF AN INVESTIGATION OF THE 0.003-SCALE SPACE SHUTTLE EXTERNAL TANK MSFC MODEL 460 IN THE NASA/MSFC 14 X 14 INCH TRISONIC WIND TUNNEL TO DETERMINE STATIC PRESSURE DISTRIBUTIONS DURING REENTRY (TA2F), VOLUME 3**
P. E. Ramsey and G. W. Winkler (Northrop Serv., Inc., Huntsville, Ala.) Nov. 1975 853 p refs
(Contract NAS9-13247)
(NASA-CR-141825; DMS-DR-2165-Vol-3) Avail: NTIS HC $21.25 CSCL 22B

Static pressure distributions for the external tank (ET) at reentry conditions are presented. Basic configuration of the model was the MCR 0200 ET modified to include a rectangular crossbar at the aft ET/orbiter attach point. Mach numbers were 1.96, 3.48, and 4.96. Reynolds number per foot at these Mach numbers were 6.95 million, 6.42 million, and 4.95 million, respectively. Angle of attack range was -8 to 100 degrees and roll angle was 0 to 315 degrees. Author

**N76-16156#** British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronics and Space Systems Group.
**EXOSAT STUDY E: ADDITIONAL SYSTEM STUDY WITH EMPHASIS ON AOCS**
[1975] 43 p
(Contract ESTEC-2364/75-PP)
(CX-0073-1; ESA-CR(P)-683-2) Avail: NTIS HC $4.00

A system study is presented for the European X-ray Observatory Satellite (Exosat) design with emphasis on the attitude and orbit control system, using results of previous studies, as a baseline. Some modifications are proposed. Angled star trackers are preferred to the baseline solution in which star trackers were boresighted and modified to allow moon or earth tracking. Attitude control using reaction wheels is preferred to limit cycle operation using gas jets. The updated baseline caters to the pointing accuracy requirements. The absolute accuracy of determining the position of an X-ray source is estimated to be 1.0 arcminute in arbitrary pointing. The relation accuracy of determining the position of an X-ray source is estimated to be 12.4 arcseconds for long term experiments and 11.5 arcseconds short term. Occultations within the desired latitude range on the lunar limb may not be achieved if the location of the X-ray source is ill-defined. Maximum allowable position error (3pi) = 0.75 arcmin. Recommendations are made for further detailed studies. ESA

**N76-16157#** British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronics and Space Systems Group.
**EXOSAT STUDY E: ATTITUDE AND ORBIT CONTROL SUBSYSTEM SPECIFICATION**
11 May 1975 40 p
(Contract ESTEC-2364/75-PP)
(CX-0074; ESA-CR(P)-683-3) Avail: NTIS HC $4.00

The performance, design, interface, and test requirements are established for the attitude and orbit control subsystem for the European X-Ray Observatory Satellite (Exosat). ESA

**N76-16158#** Hawker Siddeley Dynamics Ltd., Hatfield (England). Space Div.
**THE ACOUSTIC EXCITATION OF STRUCTURES, PHASE 2 Final Report**
J. J. Pocha Jul. 1975 110 p refs
(Contract ESTEC-2143/73-PP)
(HSD-TP-7535; ESA-CR(P)-733) Avail: NTIS HC $5.50

The statistical energy method was used to evaluate the acoustic response of complex structures. It has been shown that for the structures considered the interstructure coupling is strong, and the principle of equipartition of energy can be used to simplify the analysis. The test program undertaken in support of the theoretical development indicated that the agreement between theoretical predictions and test results was, on the whole, quite good. One can, therefore, have confidence in the theoretical predictions of the acoustic response of the type of structures considered here. The theory was incorporated into a computer

program to provide the spacecraft designer with a useful and powerful analytical tool. Author (ESA)

**N76-16159#** British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronics and Space Systems Group.
**A STUDY OF ATTITUDE CONTROL AND STABILISATION SYSTEMS VIA GROUND CONTROL Final Report**
D. R. Smart and W. J. Hutcheson Oct. 1975 349 p refs
(Contract ESTEC-2274/74-AK)
(ESS/SS-672; ESA-CR(P)-735) Avail: NTIS HC $10.00

A number of satellite missions are analyzed with the aim of identifying those for which via the ground control is considered feasible for attitude and stabilization, and the merits of such a concept for those missions is assessed. A preferred mission was selected for more detailed study:a three axis stabilized geosynchronous communication satellite. Actuators considered are a double gimballed wheel, a single gimballed wheel, and a fixed wheel. The satellite configuration and hardware assumed for this mission are representative of that which might be flown on an European Communications Satellite (ECS) mission in the near future. It is technically feasible to control all modes of operation for ECS in a via the ground manner. Ground and space segments are detailed. Author (ESA)

**N76-16160#** Logicon, Inc., Torrance, Calif.
**DYNAMICS OF SATELLITE WIRE-BOOM SYSTEMS**
Shu T. Lai and Krisin H. Bhavnani 28 Feb. 1975 240 p refs
(Contract F19628-75-C-0039)
(AD-A014859; AFCRL-TR-75-0220; SR-1) Avail: NTIS CSCL 22/2

A theoretical analysis and computer simulation problem was completed, involving the mathematical formulation, derivation, and computation of all mode characteristics of a coupled spinning satellite hub-wire boom system. The digital simulation generates the time-dependent behavior of the satellite system under different experimental conditions. Author

**N76-16161#** ARO, Inc., Arnold Air Force Station, Tenn.
**AEROTHERMAL TESTS OF THE SPACE EXTERNAL TANK INSULATING MATERIAL Final Report, 12 Jan. - 13 Feb. 1975**
R. K. Matthews and D. C. Harper AEDC Nov. 1975 39 p refs
(ARO Proj. V41C-91A; AF Proj. 921E)
(AD-A017497; ARO-VKF-TR-75-57; AEDC-TR-75-94) Avail: NTIS CSCL 16/3

Aerothermal tests were conducted to evaluate the performance of a candidate material for the insulation of the Space Shuttle external tank. Material samples were exposed to total temperatures and heating rates designed to simulate those experienced during the ascent phase of the Shuttle trajectory. These conditions were obtained in the VKF Hypersonic Wind Tunnel (C), where a large wedge was used to hold the sample and the wedge angle was varied to produce the desired heating rates and pressures on the wedge surface. Photographic coverage of the material performance was obtained at wedge angles from 0 to 38 deg. Selected test results are presented which show the ablation/erosion characteristics of the material.Author (GRA)

# 19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

**N76-16162*#** Norden, Norwalk, Conn.
**LASER SPACE RENDEZVOUS AND DOCKING SYSTEM TRADE-OFF STUDY Final Report, 27 May - 21 Dec. 1975**
S. Adelman and S. Levinson Dec. 1975 20 p refs
(Contract NAS8-31489)
(NASA-CR-144150; Rept-1257-R-0001) Avail: NTIS HC $3.50 CSCL 14B

The use, design, and fabrication feasibility of scanning the laser beam by swiveling the outside mirror with a ball joint swivel system is examined along with the applicability of graphite reinforced epoxy material for the construction of reflective optics. It is indicated that (1) the cost of graphite-epoxy will be more than that of many other materials due to the amount of special tooling required; (2) the weight advantage of graphite-epoxy over beryllium is minimal; the ball joint swivel system is accurate enough to perform the scanning function; and that the ball joint will result in a simpler and more cost effective scanning mechanism. Author

**N76-16163*#** Aerojet Electrosystems Co., Azusa, Calif.
**PRELIMINARY DESIGN STUDY. SHUTTLE MODULAR SCANNING SPECTRORADIOMETER Final Report, 20 Jun. 1974 - 30 Nov. 1975**
Dec. 1975 247 p refs
(Contract NAS9-14243)
(NASA-CR-147430; AESC-5231) Avail: NTIS HC $8.00 CSCL 14B

Fundamental concepts on which to base a detailed design for a Shuttle Modular Scanning Spectroradiometer were developed, and a preliminary design is presented. The recommended design features modularity and flexibility. It includes a 75-cm f/1.7-telescope assembly in an all-reflective Schmidt configuration, a solid state scan system (pushbroom) with high resolution over a 15 deg field of view, and ten detector channels covering the spectral range from 0.45 to 12.5 micrometers. It uses charge transfer device techniques to accommodate a large number of detector elements for earth observation measurements. Methods for in-flight radiometric calibration, for image motion compensation, and for data processing are described. Recommendations for ground support equipment are included, and interfaces with the shuttle orbiter vehicle are illustrated. Author

**N76-16164*#** Magnavox Research Labs., Torrance, Calif. Research Labs.
**TDRSS MULTIMODE TRANSPONDER PROGRAM S-BAND MODIFICATION Final Report, May 1974 - Nov. 1975**
Joseph E. Mackey 19 Dec. 1975 150 p
(Contract NAS5-20330)
(NASA-CR-144722; R-5188) Avail: NTIS HC $6.00 CSCL 14B

The S-Band TDRS multimode transponder and its associated ground support equipment is described. The transponder demonstrates candidate modulation techniques to provide the required information for the design of an eventual S-band transponder suitable for installation in a user satellite, capable of operating as part of a Tracking and Data Relay Satellite (TDRS) system. Author

**N76-16165*#** Quanta Systems Corp., Rockville, Md.
**HELIOS DUAL SWEPT FREQUENCY RADIOMETER Final Report**
James R. White 11 Sep. 1975 265 p
(Contract NAS5-11396)
(NASA-CR-144718; FR-3436) Avail: NTIS HC $9.00 CSCL 14B

The HELIOS dual swept frequency radiometer, used in conjunction with a dipole antenna, was designed to measure electromagnetic radiation in space. An engineering prototype was fabricated and tested on the HELIOS spacecraft. Two prototypes and two flight units were fabricated and three of the four units were integrated into the HELIOS spacecraft. Two sets of ground support equipment were provided for checkout of the radiometer. Author

**N76-16166*#** Martin Marietta Corp., Denver, Colo.
**DESIGN AND DEVELOPMENT OF A UNIFIED SYSTEM FOR DETECTION OF LIFE ON MARS Supplementary Final Report**
Dec. 1975 81 p
(Contract NAS2-7834)
(NASA-CR-137806; MCR-75-493) Avail: NTIS HC $5.00 CSCL 14B

The design, fabrication, testing, and evaluation of components for a modularized engineering prototype of a unified system for detection of life on Mars is summarized. Author

**N76-16167*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**EXPERIMENT POINTING SUBSYSTEMS (EPS) REQUIREMENTS FOR SPACELAB MISSIONS**
M. E. Nein and P. D. Nicaise Dec. 1975 42 p
(NASA-TM-X-64978) Avail: NTIS HC $4.00 CSCL 14B

The goal of the experiment pointing subsystems (EPS) is to accommodate a broad spectrum of instrument types by providing a number of stability and control functions that greatly exceed the capability of the shuttle. These functions include target acquisition, target tracking through wide gimbal ranges, stabilization, simultaneous pointing to one or more targets, instrument rastering, and on-orbit calibration. The experiments will vary widely in size, weight, geometry, and instrument types, and many have not been completely defined. This great diversity of requirements reflects the long term plans of the user community and establishes challenging performance requirements for the EPS. Author

# 20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**N76-16168*#** Scientific Translation Service, Santa Barbara, Calif.
**FEASIBILITY OF AN ION ENGINE FOR ENGINEERING TEST SATELLITE. 3: EXAMINATION OF ELECTRONIC INSTRUMENTS MOUNTED ON THE SATELLITE 3 FOR THE PURPOSE OF TECHNICAL STUDY**
Isao Kudo Washington NASA Dec. 1975 219 p Transl. into ENGLISH from "Gijutsu Shiken Eisei 3 Gata Tosai Denshi Kiki Kento: Ion Enjin Shisutem" Tokyo, Oct. 1975 264 p
(Contract NASw-2791)
(NASA-TT-F-16674) Avail: NTIS HC $7.75 CSCL 21C

Design constraints and characteristics are described of a Japanese (mercury) ion engine for spacecraft attitute control. Specifications for engine tests are given: starting sequence, data transmission, checkout. The ETS-III satellite mission for engine checkout is discussed. A historical summary of Japanese ion engine research is presented, including a detailed discussion of design parameters, reliability, and future space missions. Author

**N76-16169*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE EFFECTS OF SOLID ROCKET MOTOR EFFLUENTS ON SELECTED SURFACES AND SOLID PARTICLE SIZE, DISTRIBUTION, AND COMPOSITION FOR SIMULATED SHUTTLE BOOSTER SEPARATION MOTORS**
David W. Jex, Roger C. Linton, William M. Russell, John J. Trenkle, and Donald R. Wilkes 12 Jan. 1976 218 p
(NASA-TM-X-64975) Avail: NTIS HC $7.75 CSCL 21H

A series of three tests was conducted using solid rocket propellants to determine the effects a solid rocket plume would have on thermal protective surfaces (TPS). The surfaces tested were those which are baselined for the shuttle vehicle. The propellants used were to simulate the separation solid rocket motors (SSRM) that separate the solid rocket boosters (SRB) from the shuttle launch vehicle. Data cover: (1) the optical effects of the plume environment on spacecraft related surfaces, and (2) the solid particle size, distribution, and composition at TPS sample locations. For individual titles, see N76-16170 through N76-16172.

**N76-16170*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE PLUME IMPINGEMENT TEST PROGRAM AT AEDC UTILIZING THE S-2 ULLAGE MOTORS (NOVEMBER 1973), SECTION 1**
*In its* The Effects of Solid Rocket Motor Effluents on Selected Surfaces and Solid Particle Size, Distribution, and Composition for Simulated Shuttle Booster Separation Motors 12 Jan. 1976 p 12-95 (For availability see N76-16169 07-20)
CSCL 21H

Proposed experiments for analyzing rocket plumes are reported. Two groups of experiments were studied: (1) those that would help define some of the parameters that characterize the plume and (2) those that would enable evaluation of some of the contamination effevts of the plume environment on various items of interest. The items investigated, the purpose of the investigation, are given in tabular form. Author

**N76-16171*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE SMALL MOTOR PLUME/MATERIAL IMPINGEMENT TEST PROGRAM AT MSFC UTILIZING NINE DIFFERENT PROPELLANT FORMULATIONS (APRIL AND MAY 1974), SECTION 2**
*In its* The Effects of Solid Rocket Motor Effluents on Selected Surfaces and Solid Particle Size, Distribution, and Composition for Simulated Shuttle Booster Separation Motors 12 Jan. 1976 p 96-151 (For availability see N76-16169 07-20)
CSCL 21H

The relative effects of several candidate SSRM propellant formulations and their plume impingement effects on HRSI and RCC materials were evaluated. Nine solid propellant formulations were tested. The selected propellant matrix allowed an evaluation of propellants with and without metal additives, with and without burning rate catalyst, and low (approximately 1927 C) and high (approximately 2649 C) combustion temperatures. Motors were fired at a simulated SRB staging altitude of 3.96 km (130,000 ft) (nominal). The altitude pressure was predicted to drop approximately 0.6 km (20,000 ft) during a motor firing. All motors were loaded with 1.8 to 2.3 kg (4 to 5 lb) of propellant and burned for approximately 2 s. Author

**N76-16172*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE LARGE MOTOR PLUME/MATERIAL IMPINGEMENT TEST PROGRAM AT AEDC UTILIZING THE FOUR SELECTED PROPELLANTS FROM THE SMALL MOTOR TESTS AT MSFC (JULY, AUGUST, AND SEPTEMBER 1974), SECTION 3**
*In its* The Effects of Solid Rocket Motor Effluents on Selected Surfaces and Solid Particle Size, Distribution, and Composition for Simulated Shuttle Booster Separation Motors 12 Jan. 1976 p 152-203 (For availability see N76-16169 07-20)
CSCL 21H

Efforts made to determine the vulnerability of Orbiter and ET materials located at various positions within exhaust plumes from test SSRM's using four different propellant formulations are discussed. Data also cover the effect on TPS materials from a single SSRM plume and dual SSRM plumes, and definitions of test SSRM plume environment at material specimen locations. Author

**N76-16173*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**NUCLEAR ENERGY WASTE-SPACE TRANSPORTATION AND REMOVAL**
R. E. Burns Dec. 1975 87 p refs
(NASA-TM-X-64973) Avail: NTIS HC $5.00 CSCL 21C

A method for utilizing the decay heat of actinide wastes to power an electric thrust vehicle is proposed. The vehicle, launched by shuttle to earth orbit and to earth escape by a tug, obtains electrical power from the actinide waste heat by thermionic converters. The heavy gamma ray and neutron shielding which is necessary as a safety feature is removed in orbit and returned to earth for reuse. The problems associated with safety are dealt with in depth. A method for eliminating fission wastes via chemical propulsion is briefly discussed. Author

**N76-16174*#** Transemantics, Inc., Washington, D.C.
**ROCKET ENGINES OF THE GAS DYNAMICS LABORATORY-EXPERIMENTAL DESIGN BUREAU**
V. P. Glushko Washington NASA Feb. 1976 73 p refs Transl. into ENGLISH of the book "Raketnyye Dvigateli GDL-OKB" Moscow, Novosti Press, 1975 26 p
(Contract NASw-2792)
(NASA-TT-F-16847) Avail: NTIS HC $4.50 CSCL 21H

Work in developing high-performance liquid fuel rockets is summarized along with the contributions of the Gas Dynamics

Laboratory-Experimental Design Bureau in these developments. A brief chronology of rocket engine building in the U.S.S.R., illustrations of rocket engines and vehicles, and a listing of scientists involved in rocket technology are included. M.J.S.

**N76-16175*#** Louisville Univ., Ky. School of Engineering and Applied Science.
**SSME TURBOPUMP TECHNOLOGY IMPROVEMENTS VIA TRANSIENT ROTORDYNAMIC ANALYSIS Final Report, 1 Nov. 1974 - 31 Jan. 1976**
Dara W. Childs 22 Dec. 1975 122 p refs
(Contract NAS8-31233)
(NASA-CR-144165) Avail: NTIS HC $5.50 CSCL 22B

The rotordynamic behavior of the high pressure oxygen turbopump and high pressure fuel pump was analyzed for the Space Shuttle Main Engine. The identification of potential rotordynamic problem areas which might arise during operation of these units prior to their testing was accomplished. Alternative procedures for correcting potential rotordynamic problems should they occur were investigated. An adequate analytic and physical understanding of the turbopump rotordynamics was developed to improve the probability of a correct diagnosis of rotordynamic problems from test data. Transient rotordynamic models were developed for both turbopumps. The transient models model the hydrodynamic forces of the turbopump seals. A linear stability analysis was performed for the turbopump rotordynamics models, which included gyroscopic effects, seal forces, speed-dependent bearing characteristics, and internal rotor damping. Results are presented and discussed. Author

**N76-16176*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECT OF TIP CLEARANCE ON PERFORMANCE OF SMALL AXIAL HYDRAULIC TURBINE**
James L. Boynton and Harold E. Rohlik Jan. 1976 29 p refs
(NASA-TM-X-3339; E-8370) Avail: NTIS HC $4.00 CSCL 21E

The first two stages of a six stage liquid oxygen turbine were tested in water. One and two stage performance was determined for one shrouded and two unshrouded blade end configurations over ranges of clearance and blade-jet speed ratio. First stage, two stage, and second stage efficiencies are included as well as the effect of clearance on mass flow for two stage operation. Author

# 23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

**N76-16177*#** Worcester Polytechnic Inst., Mass. Dept. of Chemical Engineering.
**EDIBLE CARBOHYDRATES FROM FORMALDEHYDE IN A SPACECRAFT Final Report, 1 Jul. 1974 - 31 Dec. 1975**
Alvin H. Weiss 31 Dec. 1975 23 p refs
(Grant NGR-22-017-024)
Avail: NTIS HC $3.50 CSCL 07C

The autocatalytic nature of the base catalyzed condensation of formaldehyde to formose sugars is eliminated by using as a cocatalyst, an aldose, or ketose having an alpha-hydrogen. This is more strongly complexed by base than is formaldehyde and the cocatalyst and sugar products accumulate as catalyst complexes instead of formaldehyde. Because of the presence of alpha-hydrogen atoms in cocatalysts and formose sugars, their removal by cross Cannizzaro reaction of complexed sugars does not occur, so the formose reaction behaves autocatalytically due to this accumulation. It is believed that a given catalytic formose complex is not a discrete complexed sugar, but rather, a scrambled dynamic mixture of sugars having weakened structures. The sugar complexes derive from a common salt-like formaldehyde complex, which, because of the absence of alpha-hydrogen, has a greater tendency to undergo Cannizzaro reaction, rather than formose condensation. Because of this, the Cannizzaro reaction can proceed without measurable formose condensation. The reverse is not possible. Author

**N76-16178*#** Kanner (Leo) Associates, Redwood City, Calif.
**THE ACTION OF NITROLIC ACIDS ON COMPOUNDS CONTAINING A TRIPLE BOND. NOTE 6: THE FULMINIC SYNTHESIS OF ISOXAGOLES**
A. Quilico (Polytech. School of Milan, Italy) and M. Simonetta (Polytech. School of Milan, Italy) Washington Feb. 1976 20 p refs Transl. into ENGLISH from Gazz. Chim. Ital. (Rome), v. 76, 1946 p 200-214
(Contract NASw-2790)
(NASA-TT-F-16865) Avail: NTIS HC $3.50 CSCL 07C

The action of nitrolic acids on triple bond compounds yields formation of isoxagolic derivatives through intermediary action of various nitroloxides. Study of this action elucidates isoxagolic formation from reactions among nitric acid, acetylene, and unsaturated compounds. Author

**N76-16179*#** Transemantics, Inc., Washington, D.C.
**PREPARATION OF 1,2,4-OXADIAZOLES BY DIPOLAR ADDITION TO ALIPHATIC NITRILE OXIDES**
F. Eloy Washington NASA Jan. 1976 10 p refs Transl. into ENGLISH from Bull. Soc. Chim. Belges (Brussels), v. 73, no. 9/10, 1964 p 793-798
(Contract NASw-2792)
(NASA-TT-F-16861) Avail: NTIS HC $3.50 CSCL 07C

The preparation of 1,2,4-oxadiazoles by condensation of an aliphatic nitrile oxide with a nitrile is described. The nitrile is formed 'in situ' by treating a nitroalkane with an isocyanate in the presence of a tertiary base. The nitrile must be activated by an electron-withdrawing substance. Author

# 24 COMPOSITE MATERIALS

Includes laminates.

**N76-16180*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
**AN INVESTIGATION OF THE FAILURE AND FRACTURE BEHAVIOR OF GRAPHITE/EPOXY LAMINATES Final Report, 1 Oct. 1974 - 30 Sep. 1975**
H. F. Brinson and Y. T. Yeow Sep. 1975 115 p refs
(Grant NsG-2038)
(NASA-CR-146135; VPI-E-75-23) Avail: NTIS HC $5.50 CSCL 11D

A fundamental investigation of the fracture behavior of fiber reinforced composites is discussed. It is suggested that experimental and analytical investigations should compliment each other. Further, it is suggested that in order to understand and mathematically model composite fracture it is necessary to explore, understand and characterize the stress-strain behavior of each type of laminate tested from initial loading to incipient fracture. That is, it is not only necessary to perform fracture studies but it is necessary to perform stress-strain characterization and failure studies as well. For this reason a literature survey is presented in which these three elements are discussed. An experimental program to determine tensile properties of unnotched and notched unidirectional and multi-directional laminates composed of Hercules AS Fiber and 3501 Resin is described. Experimental unnotched moduli and strengths are presented, discussed and compared to lamination theory predictions. It is shown that rate effects are small and that lamination theory gives good results for moduli but not for strengths. Author

**N76-16181*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**IMPROVED METHOD OF MAKING REINFORCED COMPOSITE STRUCTURES Patent Application**
Lee C. McCandless (General Technologies Corp., Reston, Va.) and Glen E. Weber, inventors (to NASA) (General Technologies Corp., Reston, Va.) Filed 19 Apr. 1974 16 p
(Contract NAS3-15828)
(NASA-Case-LEW-12619-1; US-Patent-Appl-SN-462424) Avail: NTIS HC $3.50 CSCL 11D

A process is reported for making reinforced matrix composite structures of the type where reinforcing filament is wound on a body and metallic matrix material is electroformed on and between the windings to form each new layer of composite structure.

The matrix material is then machined until a new smooth surface is attained on which to precision-wind the next filament convolutions with their flat sides in close contact and with the spacings between convolutions very closely controlled. NASA

**N76-16182#** Sandia Labs., Albuquerque, N.Mex.
**COMPATIBILITY OF DIELECTRIC AND HEAT SHIELD MATERIAL COMBINATIONS DURING ABLATIONS**
K. E. Mead, R. E. Sheldahl, and G. F. Wright Jul. 1975 41 p refs
(Contract AT(29-1)-789)
(SLA-74-0157) Avail: NTIS HC $4.00

The surface recession and mass transfer rates of materials suitable for reentry thermal protection of microwave antennas were examined. Experiments were performed with subsonic turbulent flow of air in a confined channel. In supporting experiments, selected material combinations were subjected to ablative splash tests in the Sandia High Enthalpy Arc Tunnel. Microwave window materials were tested adjacent to ablative heat shield materials in combinations and configurations under consideration for reentry vehicle applications. Test results indicated that fused silica was compatible with quartz-phenolic and carbon-phenolic heat shield materials while the ablative characteristics of hot-pressed boron nitride were very similar to those of the STC-7 carbon composite. Author (NSA)

**N76-16183#** Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
**SUPPLEMENT NON-WOOD PALLET PROGRAM Interim Report**
Albert J. Barringer 30 Oct. 1975 4 p
(AFPEA Proj. 74-P7-28)
(AD-A017514; DSPD-75-67) Avail: NTIS CSCL 15/5

Significant progress has been made to develop pallets made from materials including plastics, paperboard, steel, aluminum, and various combinations. The wood shortages and rising costs have compelled pallet users to consider alternate materials. The versatility of plastics has been recognized and accepted by many manufacturers and is 'knocking on the door' of the DOD pallet situation. Although many designs are acceptable, certain pallet materials, when subjected to elevated temperatures in the range of 140F to 160F, or subjected to the static loading associated with storage, do not meet DOD requirements. Excessive deflection is the main cause for rejection in both cases. This report outlines progress made on the Supplemental Non-Wood Pallet Program towards establishing criteria for non-wooden general cargo pallets for use within the DOD material handling systems. GRA

# 25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

**N76-16184#** Royal Aircraft Establishment, Farnborough (England).
**INVESTIGATIONS INTO ADHESION INTERACTIONS BETWEEN RESINS AND METALS**
W. Brockmann Nov. 1975 21 p refs Transl. into ENGLISH from Adhaesion (Berlin), v. 19, no. 2, 1975 p 34-39
(RAE-Lib-Trans-1864; BR50203) Copyright. Avail: NTIS HC $3.50

Peel strengths for aluminium bonded with phenolic adhesive, measured before and after exposure to steam at 133 C, were markedly affected by the pretreatment, with anodising giving the highest strength and durability. Chelating agents applied to the pretreated aluminium were beneficial with etch pretreatments. Scanning electron micrographs and autoradiographs of the peeled aluminium surfaces suggest that fracture occurs within the adhesive close to the interface. Results are discussed in relation to adsorption of adhesive resin by the adherend. Degradation of adhesive very close to the interface is critical, and adherend pretreatment affects the structure, and hence water-resistance, of this zonz. Author

**N76-16185#** Royal Aircraft Establishment, Farnborough (England).
**STUDIES OF THE KINETICS AND MECHANISM OF THE OXIDATION OF PETROLEUM HYDROCARBONS IN THE GAS PHASE. PART 6: KINETIC INVESTIGATION OF THE OXIDATION OF n-HEPTANE IN THE LOW TEMPERATURE REGION**
G. Lischke, G. Ohlmann, and W. Schirmer Oct. 1975 16 p refs Transl. into ENGLISH from Z. Phys. Chem. (Leipzig), v. 230, 1965 p 73-84
(RAE-Lib-Trans-1870; BR50203) Avail: NTIS HC $3.50

The gas phase oxidation of n-heptane was studied in the temperature range from 190 to 215 C; it was possible to determine the dependence of the maximum attainable reaction rate upon the initial pressure of the reaction components and upon the temperature. In the case of heptane, a linear correlation is found between the maximum reaction rate and the initial concentration. In the case of mixtures containing excess oxygen, the initial oxygen concentration has practically no effect on the value of the maximum reaction rate. An attempt was made to discover a reaction mechanism which corresponded to the kinetic results obtained. The activation energy of the total process was calculated to be 38 + or - 2.5kcal/mole. Author

**N76-16186#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**INVESTIGATION OF THE GASLESS COMBUSTION PROCESS FOR DIVERSE METAL POWDER MIXTURES. 2: INFLUENCE OF MIXTURE COMPOSITION ON THE PHASE COMPOSITION OF COMBUSTION PRODUCTS AND VELOCITY**
Iu. S. Naiborodenko and V. I. Itin 1975 5 p refs Transl. into ENGLISH from Fiz. Goren. i Vzryva (USSR), v. 11, no. 5, 1975 p 734-738
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library Chicago, Illinois 60616

A simple economical self propagating high temperature synthesis process and its use in the development of an optimal technology for intermetallic compounds and materials was studied. Different factors-briquette porosity, component dispersion, and degree of dilution-and their influence on the combustion velocity and mode were included. Combustion product composition was studied by X-ray diffraction, micro-X-ray spectrum, and metallographic methods, while gas adsorbed on the particles was determined using a mass spectrometer analysis. Author

**N76-16187+** Lockheed Missiles and Space Co., Palo Alto, Calif.
**INVESTIGATION OF THE PROCESS OF GASLESS COMBUSTION OF DIVERSE METAL POWDERS. 1: COMBUSTION REGULARITIES AND MECHANISM**
Iu. S. Naiborodenko and V. I. Itin 1975 13 p refs Transl. into ENGLISH from Fiz. Goren. i Vzryva (USSR), v. 11, no. 3, 1975 p 343-353
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

Fundamental regularities of gasless combustion, due to reactions in the condensed phase, are studied in the so-called gasless compounds; these include mixtures of metals with oxides, boron, carbon, and other metals. Special attention was given to gasless combustion mixtures of aluminum powders with nickel, or cobalt. Possible mechanisms for the combustion of such systems are analyzed. Author

**N76-16188#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**THEORETICAL AND EXPERIMENTAL ASPECTS OF GEL-FILTRATION**
A. Araco 2 Dec. 1974 61 p refs In ITALIAN; ENGLISH summary
(ISS-R-74/14) Avail: NTIS HC $4.50

A short review is presented on analytic gel-filtration. The basic operating principles are first described together with the main theories on gel-filtration mechanism. Practical information is then given about the preparation and use of gel-chromatographic

columns. Finally, some typical applications of gel-filtration are considered, i.e. the evaluation of the molecular weights of homogeneous solutes and the analysis of the molecular weight distribution of nonhomogeneous solutes. Author

**N76-16189*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.
**ANALYTICAL DEVICES IN THE CHEMICAL INDUSTRY PAVILION**
A. Amannazarov Washington NASA Jan. 1976 22 p refs Transl. into ENGLISH from Prib. Sist. Upr. (USSR), v. 6, 1973 p 60-64
(Contract NASw-2789)
(NASA-TT-F-16675) Avail: NTIS HC $3.50 CSCL 07D

The specifications and operation of Soviet gas-analyzing devices are presented. Devices include coulometers, a dielcometer, an oxygen analyzer, gas analyzers, liquid analyzers, gas chromatographs, and spectrophotometers. M.J.S.

**N76-16190*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.
**ULTRAVIOLET ABSORPTION SPECTRA OF NITROSYL BISULFATE IN MIXTURES OF SULFURIC ACID AND WATER**
Jean M. R. Deschamps Washington NASA Jan. 1976 5 p refs Transl. into ENGLISH from Comp. Rend. (Paris), v. 215, no. 17, 1957 p 1432-1434
(Contract NASw-2789)
(NASA-TT-F-16878) Avail: NTIS HC $3.50 CSCL 07D

The ultraviolet absorption spectra of nitrosyl bisulfate in sulfuric acid and water mixtures of varying concentrations between 96 and 70% exhibit an isosbestic point. The two absorbing components are the nitroso ion and probably the proton-supplemented nitrous acid ion. Author

**N76-16191#** National Aviation Facilities Experimental Center, Atlantic City, N.J.
**A PRELIMINARY COMPARISON OF LABORATORY METHODS FOR ASSIGNING A RELATIVE TOXICITY RANKING TO AIRCRAFT INTERIOR MATERIALS Final Report, Jul. - Oct. 1974**
Joe C. Spurgeon Oct. 1975 40 p refs
(AD-A018148/7; FAA-NA-74-57; FAA-RD-75-37) Avail: NTIS HC $4.00 CSCL 14/2

Thirteen aircraft interior materials were tested in order to compare the National Bureau of Standards (NBS) smoke chamber and the microcombustion tube furnace. The microcombustion tube furnace ranked nitrogen- and chloride-containing test materials of known composition according to the expected order based upon HCN and HC1 concentrations. The nitrogen-containing test materials were not ranked in the expected order in the NBS smoke chamber. Several methods of sampling combustion gases from the NBS smoke chamber have been investigated in an attempt to maximize sample recovery. In general, syringe sampling resulted in the best sample recoveries. Animal toxicity tests were conducted for nine aircraft interior materials using Sprague-Dawley rats by exposing the test animals to the combustion products. A preliminary correlation of animal toxicity data with measured gas concentrations indicates that a possible relationship exists between times-to-incapacitation and hydrogen cyanide concentrations produced by the test materials. Author

**N76-16192#** Technische Hochschule, Aachen (West Germany). Lab. fuer Ultraschall.
**INVESTIGATIONS ON ACCELERATION AND CONTROL OF THE WET CHEMICAL ETCHING PROCEDURE USING ULTRASONIC CAVITATION Final Report [UNTERSUCHUNGEN UEBER BESCHLEUNIGUNG UND STEUERUNG NASSCHEMISCHER AETZVERFAHREN DURCH GEZIELTE ULTRASCHALLKAVITATION]**
D. Leven and R. Pohlman 1974 34 p refs In GERMAN Sponsored by Deut. Forschungsgemeinschaft
Avail: NTIS HC $4.00

The influence of ultrasonic and electric current on etching speed and etching quality was investigated. Tests were carried out with solution of ferric chloride, ammonium chloride or cupric chloride in water, or a mixture of phosporic acid, water, and nitric acid as etching liquids, and with copper wire, platinum on pertinax or on glass epoxy resin, silicon disks, or copper stannide or brass strips as etching probes. Ultrasonic frequencies used were 20,40 and 800 kHz. Both ultrasonic waves and electric current accelerate the etching process, the effects being additive; acceleration rates up to 3 or 4 can be achieved. Since it was not possible to produce gas bubbles on the surfaces to be etched, controllable cavitation etching could not be realized. ESA

**N76-16193#** Chicago Univ., Ill. James Franck Inst.
**CROSSED MOLECULAR BEAM STUDY OF THE REACTIONS OF OXYGEN ATOMS AND FREE RADICALS**
Yuan Tseh Lee 15 Aug. 1975 11 p refs
(Contract N00014-67-A-0285-0017; NR Proj. 092-545)
(AD-A014909) Avail: NTIS CSCL 07/4

The development of rare gas seeded fluorine atom beam source and reactions studied by this new source are main subject of this brief final report. F+CH3I to IF + CH3 reaction has been studied. GRA

**N76-16194#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**KINETICS, MECHANISTICS, AND ENERGY TRANSFER BY THE QUASICLASSICAL TRAJECTORY ANALYSIS OF POTENTIAL ENERGY FUNCTIONS Final Report, 1 Sep. 1972 - 31 Aug. 1974**
Darrel G. Hopper Jun. 1975 144 p refs
(AF Proj. 7023)
(AD-A014773; ARL-75-0222) Avail: NTIS CSCL 07/4

A generalized formulation of a multiple integral equation for the calculation of rate is developed. Depending upon the number and kind of variables not integrated there obtains from the general equation an expression of rate in terms of rate constants, cross-sections, differential cross sections, doubly differential cross sections, reaction probability as a function of impact parameters, etc. Half of the variables here mentioned are those that determine the initial position and motion status of two molecules approaching a collision with one another and of their component atoms. The other half of the variables are those determining the position and motion status of the two to three molecules and their component atoms that result from the collision. A formal evaluation of this multiple integral equation is developed in terms of the completely detailed transform probability. This formal evaluation yields working equations for the computation of the above listed specific rate expressions in terms of the partially integrated transform probability. The use of tabulated (e.g. ab initio) potential energy surfaces is developed along three lines. Lastly, a method is outlined for the extension of the classical trajectory method for evaluation of the transform probabilities P(JI) to multi-potential energy function. GRA

**N76-16195#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPROVING RELIABILITY IN COMPUTER-AIDED IDENTIFICATION OF CHEMICAL SPECTRA. AN APPROACH BASED UPON HYPOTHESIS TESTING Final Technical Report**
Stanley L. Grotch 1 Sep. 1975 29 p refs
(Contract NAonr-42-75; NR Proj. 051-597)
(AD-A014620; TR-1) Avail: NTIS CSCL 07/4

The maximum likelihood approach suggested by H. Chernoff was extended to multiple mass spectra levels using a new theoretical model. Limited tests of the new results were disappointing. The major deficiency of the model is that the error variance is assumed to be a constant independent of intensity level which is not in accordance with observed data. An alternative, simpler, but more empirical approach is suggested to handle this problem. GRA

**N76-16196#** Naval Postgraduate School, Monterey, Calif.
**SPECTROSCOPIC EXAMINATION OF CARBON DIOXIDE LASER PRODUCED GAS BREAKDOWN M.S. Thesis**
Robert William Stevenson Jun. 1975 97 p refs
(AD-A014629) Avail: NTIS CSCL 07/4

Light from an atmospheric pressure, double-discharge CO2 laser, with a pulse length of 250 nanoseconds and energies from 0.7 to 2.5 joules, was focused in monatomic and diatomic gases at pressures from 1.0 to 8.0 atmospheres in order to produce a plasma for examination. The gases under investigation were Ar, He and N2. Properties of the plasma were determined through analysis of photographs and spectroscopic measurements.

Emission spectra in the visible range observed for all gases consisted of an early, intense continuum followed by a lesser continuum superimposed with strong and medium strength lines due to neutral and ionized atoms. Among the more structured lines observed were the argon II lines at wavelengths of 4545A, 4610A, 4765A, 4806A and 4880A. The early continuum lasted for less than 0.5 microseconds, and its appearance coincided with the arrival of the laser beam in the gas chamber. The intensity of the lines varied with wavelength, and rose to maximum intensity at times ranging from 1.6 to 2.2 microseconds after the initial continuum had begun to subside. A method for predicting plasma electron temperatures was also presented. GRA

**N76-16197#** Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
**THE APPLICATION OF HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY TO THE ANALYSIS OF PETROLEUM MATERIALS. PART 1: QUALITATIVE HYDROCARBON-TYPE ANALYSIS Final Report**
George E. Fodor and Frank M. Newman May 1975 15 p refs
(Contract DAAK02-73-C-0221)
(AD-A014994; AFLRL-62-Pt-1) Avail: NTIS CSCL 07/3

A preliminary study is presented for a method for the hydrocarbon type analysis of petroleum, its products and related substances by liquid chromatography. Elution volumes of normal-, iso-, and cyclo-paraffins, mono- and diolefins, aromatic hydrocarbons and vic-dibromo alkanes were determined by high performance liquid chromatography on 10 micrometer and 37-75 micrometer silica gel. GRA

**N76-16198#** Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
**THE APPLICATION OF HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY TO THE ANALYSIS OF PETROLEUM MATERIALS. PART 2: QUANTITATIVE HYDROCARBON-TYPE ANALYSIS Final Report**
George E. Fodor and Frank M. Newman May 1975 28 p refs
(Contract DAAK02-73-C-0221)
(AD-A014995; AFLRL-63-Pt-2) Avail: NTIS CSCL 07/3

Quantitative hydrocarbon type analysis of middle distillate petroleum products, with emphasis on straight-run (olefin-free) diesel fuels has been accomplished by high performance liquid chromatography using silica gel absorbents. GRA

**N76-16199#** Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.
**RAMAN BAND CONTOURS FOR WATER VAPOR AS A FUNCTION OF TEMPERATURE**
J. L. Bribes (Montpellier Univ.), R. Gaufres (Montpellier Univ.), M. Monan (Montpellier Univ.), M. Lapp (GE, Schenectady, N. Y.), and C. M. Penny (GE, Schenectady, N. Y.) Aug. 1975 17 p refs
(Contract N00014-67-A-0226-0005; NR Proj. 098-038; Proj. SQUID)
(AD-A014907; SQUID-TR-GE-3-PU; GE-3-PU) Avail: NTIS CSCL 07/4

A simplified method of calculation of the contour of a totally polarized Raman band for an asymmetric top molecule in the gaseous state has been applied to the v1-band of the water molecule. The good fits between computed and experimental contours from approximately 150 to 350C lay the foundation for temperature determinations for water vapor from measurements of the Raman band profile. GRA

**N76-16200#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
**ATMOSPHERIC ABSORPTION APPLIED TO PLUME EMISSION. EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF HOT GAS EMISSION ATTENUATED BY COLD GASES Final Report, 30 Mar. 1973 - 15 Oct. 1974**
G. H. Lindquist, C. B. Arnold, and R. L. Spellicy Aug. 1975 208 p refs
(Contract F04611-73-C-0008)
(AD-A015075; ERIM-102700-20-F; AFRPL-TR-75-30) Avail: NTIS CSCL 07/4

An experimental and theoretical study has been made of the atmospheric attenuation of plume radiation. A particular facet of this problem was examined, namely the effect of the correlation of the water vapor and CO2 emission lines of the plume with the corresponding absorption lines in the atmosphere. These correlations can produce lower effective transmittance of the plume radiation than the usual treatments of atmospheric attenuation predict. To measure the magnitude of correlation effects, experimental measurements were made of the radiance of a hot cell, filled with mixtures of CO2, H2O, N2 and other plume gases. These radiances were measured both unattenuated and attenuated by a long cool atmospheric path. A band model method to handle the line correlation effects was also developed. The authors were able to conclude that these correlation effects are severe enough in the 2.7 micrometers water vapor-CO2 band that their neglect can lead to an error of about 50% to a factor of two in computed radiances and radiant intensities for horizontal paths at 15 km altitude. It was also shown that the set of emission-absorption parameters compiled by Ludwig and the most commonly used to compute CO2 contributions to plume radiances, do not predict the measured emission-absorption spectra very well, while the water predictions showed adequate agreement. The measured emission-absorption spectra were also compared to the extensive line tabulation of McClatchey. GRA

**N76-16201#** Battelle Pacific Northwest Labs., Richland, Wash. Atmospheric Sciences Dept.
**PRECIPITATION SCAVENGING OF ORGANIC CONTAMINANTS Final Report**
Jeremy M. Hales and Richard N. Lee Jul. 1975 41 p refs
(Contract DAHC04-75-C-0014; BNW Proj. Y-90852)
(AD-A015019; ARO-10417.3-EN) Avail: NTIS CSCL 07/4

A gas-chromatographic technique was used to measure the solubilities of diethylamine and ethyl acetoacetate in water at low concentrations. Diethylamine solubility was found to increase with decreasing concentration and increasing acidity. Ethyl acetoacetate solubility was found to decrease with decreasing concentration. Author (GRA)

# 26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**N76-16202** Connecticut Univ., Storrs.
**EFFECTS OF VACANCY-SILICON ATOM CLUSTERS ON THE CREEP OF NiAl Ph.D. Thesis**
Robert Stephen Polvani 1975 122 p
Avail: Univ. Microfilms Order No. 76-1702

The high temperature creep behavior of NiAl was studied in an effort to understand the general role that trace impurities play in strengthening alloys. The immediate objective was to relate microscopic defect structures with the macroscopic creep behavior. A significant feature of ordered intermetallic alloys is the high concentration of vacancies which is retained by quenching from temperatures near the melting point. Although the physical characteristics of these defect structures are documented in the literature, little attention was paid to their effects on high temperature creep. Impurities, for example silicon, dramatically improve creep strength, since they can entrap and stabilize the structural vacancies by forming complexes at high temperatures. The form these defects take is critical and determines the macroscopic creep behavior. Clusters will form if NiAl is quench cooled from 1200 C and aged at 850 C. Dissert. Abstr.

**N76-16203** Northwestern Univ., Evanston, Ill.
**MICROSTRUCTURAL EFFECTS ON FATIGUE CRACK PROPAGATION IN ALUMINUM-COPPER ALLOYS Ph.D. Thesis**
Joseph Stephen Santner 1975 170 p
Avail: Univ. Microfilms Order No. 75-29744

Naturally aged 3.6 w/o Cu, 6.3 w/o Cu, and 2024 aluminum based alloys were chosen to be studied in strain control low cycle fatigue and fatigue crack propagation. The 3.6 w/o Cu alloy has planar slip and highly localized deformation while the dispersed phases cause the plastic deformation to be more homogeneously distributed. Cyclic softening occurs during strain

controlled cycling at 0.4 percent strain in the 3.6 w/o Cu alloy but not in either the 2024 alloy or the 6.3 w/o Cu alloy. The dispersed phases of the latter two alloys evidently prevent softening. Plots of log (plastic strain amplitude) vs. log (reversals to failure) for all three alloys are nonlinear showing failure of the Coffin-Manson relation. Plotting reversals to initiation rather than reversals to failure does not remove the Coffin-Manson relation failure as it does in some steels. In spite of large differences in monotonic and cyclic properties, structure, and fracture modes, the fatigue crack propagation rates, da/dN, for all three alloys in the naturally aged condition are essentially identical over the range of stress intensity. Dissert. Abstr.

**N76-16204** Northwestern Univ., Evanston, Ill.
**SINTERING OF NICKEL AND NICKEL BASE BINARY ALLOYS Ph.D. Thesis**
Bobby Ray Seidel 1975 202 p
Avail: Univ. Microfilms Order No. 75-29749

The initial and intermediate stage sintering kinetics of nickel, nickel-tungsten, nickel-molybdenum, and nickel-chromium powders were investigated. Cumulative uncertainty in quantitative metallographic intermediate stage results limited the analysis of the data by a stage sintering model. Difficulty in revealing grain boundaries, without changing the pore structures, and the presence of numerous twin boundaries made quantitative characterization of the microstructure difficult. The densification of high-purity nickel powder is shown to occur predominately by grain boundary diffusion at high temperatures. At lower temperatures and particularly at slow heating rates, plastic flow is significant. An atomistic mechanism was proposed which generates dislocation half loops associated with the grain boundary. Creep of these structures then results in densification and neck growth, and by adding steady-state creep to the diffusion densification mechanisms, theoretical computer-predicted results are found to agree with experimental results. Dissert. Abstr.

**N76-16205** Northwestern Univ., Evanston, Ill.
**THE ALLOTROPIC TRANSFORMATION IN THE Co-Cr SYSTEM PH.D. Thesis**
Min-San Cheng 1975 349 p
Avail: Univ. Microfilms Order No. 75-29598

The Co-rich side of the Co-Cr system was studied by dilatometry. A martensitic type and a nucleation and growth type of transformation mode was observed. The M sub s, A sub s, and A sub f temperatures were determined along with the thermal expansion coefficients of both FCC and HCP. The X-ray diffraction technique was used to in identify phases and measure the lattice parameters, a sub HCP, C sub HCP, and a sub FCC. The salt bath technique was used to study the massive transformation and possible precipitation. The effects of the initial FCC grain size on massive transformations were observed. Planar interfaces between FCC and HCP were studied. Octahedral plane traces were utilized to determine the approximate inclination of planar interfaces. A computer program was used to look for a matched pair of rational crystal planes, one from HCP and the other from FCC, within this range angle. Thermal faceting was directly observed in the alloys by hot stage microscopy. Thermal faceting was found to be reversible and occurred along [111] or [100] planes. Dissert. Abstr.

**N76-16206** Northwestern Univ., Evanston, Ill.
**THE EFFECTS OF MECHANICAL PROPERTIES ON FATIGUE CRACK GROWTH RATES IN Fe-Ni AND Fe-Mo ALLOYS Ph.D. Thesis**
Larry Harold Burck 1975 120 p
Avail: Univ. Microfilms Order No. 75-29589

Fatigue crack propagation data was obtained for iron and solid solution alloys of Fe-Ni and Fe-Mo over the temperature range 77 to 296 K, i.e., through the ductile-brittle transition temperature for most of the alloys. The fatigue crack growth rates were found to decrease with decreasing temperature for each alloy and to decrease with increasing solute content at 296 K but to increase with solute content at 77 K. These results are discussed in terms of the wide range of mechanical properties observed for these materials. It is shown that the transgranular fatigue crack growth rates are inversely proportional to an effective surface energy and the square of a stress approximated by the yield or ultimate stress. The iron and Fe-Mo alloys showed extensive cyclic hardening whereas the much finer grained Fe-Ni alloys showed softening at low strain ranges and only moderate hardening at higher strain ranges. This cyclic stress-strain behavior is shown to be significant in relation to the high cycle fatigue crack growth rates. Dissert. Abstr.

**N76-16207** Kansas Univ., Lawrence.
**AN ANALYSIS OF THE ELASTIC-PLASTIC FAILURE OF PRESSURE VESSEL STEELS Ph.D. Thesis**
Charles P. Royer 1975 419 p
Avail: Univ. Microfilms Order No. 76-1297

The results of investigations indicate that thin-walled pressure vessels made from common pressure vessel steels may fail by elastic-plastic fracture if a crack of significant size exists or develops in the vessel wall during its service life. In cases for which no linear elastic fracture analysis is required, a vessel might be designed based on the plastic instability mode of failure but actually fail at lower stress level by elastic-plastic fracture. A study was conducted to distinguish these two modes of failure and analyze each separately in the case of 'thin' cracked sections. For the plastic instability failure mode, the maximum shear stress theory of failure was assumed to be accurate. For cracked sections, the maximum shear stress may be calculated on the basis of the average stress in the ligament remaining under the notch. The J integral was investigated as the most promising proposed failure criterion for the fracture mode of failure. The J-integral approach was studied significantly for the case of thick plates for which the plastic zone surrounding the notch tip is contained by elastic material except at the notch tip. Dissert. Abstr.

**N76-16208** Iowa State Univ. of Science and Technology, Ames.
**SYNTHESIS AND CRYSTAL STRUCTURE OF SOME NOVEL PHASES INVOLVING METAL-METAL BONDING Ph.D. Thesis**
Douglas Guy Adolphson 1975 96 p
Avail: Univ. Microfilms Order No. 76-1815

Crystal growth and X-ray diffraction studies were carried out for zirconium monochloride and sodium heptantimonide. Single crystals of ZrCl were grown via the reaction of gaseous zirconium tetrachloride with electropolished strips of zirconium metal in sealed tantalum tube. The crystal structure was determined from three-dimensional X-ray data collected on an automated diffractometer. The crystal structure involves sheets of metal or chlorine atoms in the sequence Cl-Zr-Zr-Cl and is consistent with the graphitic character of the compound. The crystal structure of sodium hepatantimonide is discussed as the first example of a well-characterized polyatomic anion for a metallic element. Dissert. Abstr.

**N76-16209** Pennsylvania State Univ., University Park.
**AN INVESTIGATION OF THE EFFECT OF HYDROSTATIC STRESS ON THE YIELDING OF METALS Ph.D. Thesis**
William Stephan Geiger 1975 131 p
Avail: Univ. Microfilms Order No. 76-1350

The experiments were conducted using circular tubes subjected to an internal pressure, an axial load, and a superimposed hydrostatic pressure. With this method of operation, segments of the yield surface were established at various hydrostatic stress levels. Thereby, it was possible to determine the effect of hydrostatic compressive stress on the yield surface. For the material tested, magnesium alloy AZ31B, the yield stress was found to be dependent on the hydrostatic state of stress. The yield stress was found to increase approximately 18 psi with each 1,000 psi of hydrostatic compression, and the variation was reasonably linear. Using the results of the experimental investigation, hydrostatic stress dependent yield conditions were developed. These yield conditions were applied to three examples. The problems considered were bending of a cantilever beam, a thick-walled cylinder with internal pressure, and a thickwalled spherical shell under external pressure. Dissert. Abstr.

**N76-16210** New Orleans Univ., La.
**ELECTROCHEMISTRY AND ESR STUDIES OF TRANSITION METAL PORPHYRINS Ph.D. Thesis**
Carolyn McCrory Newton 1974 198 p
Avail: Univ. Microfilms Order No. 75-21965

The techniques of cyclic voltammetry, controlled-potential coulometry, and electron spin resonance (esr) and ultraviolet-visible

spectroscopy were employed to examine the redox mechanisms of the vanadium(4), chromium(3), molybdenum(5), and tungsten(5) complexes of tetraphenylporphyrin. Rate constants for the individual electron-transfer steps were determined in a number of non-aqueous aprotic solvents including dichloromethane ($CH_2Cl_2$), dimethylsulfoxide (DMSO), pyridine, N,N-dimethylacetamide (DMA), and butyronitrile (buCN). For DMSO solutions of the metalloporphyrin, the effect of added azide, cyanide, and pyridine as complexing agents was studied by means of cyclic voltammetry and ultraviolet-visible spectral data. One-electron metal reductions were observed for all but the vanadium complex, as well as a one-electron oxidation of chromium (3) to chromium (4). Dissert. Abstr.

**N76-16211** Drexel Univ., Philadelphia, Pa.
**TOUGHNESS AND FATIGUE OF IRON-BASE P/M FORGINGS Ph.D. Thesis**
Blake Lynn Ferguson 1976 181 p
Avail: Univ. Microfilms Order No. 76-787

Toughness and fatigue resistance of iron-based powder metal forgings are determined as a function of deformation involved. The dependence of these properties on lateral flow is rationalized in terms of mode of pore closure, bond integrity, and second phase morphology. Longitudinal toughness is enhanced by lateral material flow, while short transverse toughness is unaffected. Thus, toughness anisotropy increases with lateral flow. Maximum toughness can be achieved by sintering preforms at a high temperature (2300 F) in a reducing atmosphere to obtain low oxygen levels, coupled with material flow during forging. Fatigue response is dependent on both the amount of lateral flow during forging and the mode of cyclic stressing. A prototype part was forged and tested to determine the validity of laboratory test data. Preform geometries were chosen so that various levels of flow accompanied forging. Toughness and fatigue resistance increase with the amount of lateral flow. Dissert. Abstr.

**N76-16212** Iowa State Univ. of Science and Technology, Ames.
**RADIATION DAMAGE IN VANADIUM DOPED WITH OXYGEN Ph.D. Thesis**
Ram Bajaj 1975 240 p
Avail: Univ. Microfilms Order No. 76-1818

Radiation damage caused by neutron irradiation was studied in vanadium containing various amounts of oxygen by transmission electron microscopy, tensile testing, and hardness measurements. The major motive was to delineate the role of an interstitial impurity (namely oxygen) on radiation damage in vanadium. Irradiation of polycrystalline samples containing 60-640 wt. ppm oxygen was carried out at 150 C to a dose of (1.2 x 10 to the 19th power n/sq cm (E >MeV)) and tensile tests were carried out at room temperature following irradiation and post-irradiation annealing. Lower yield stress measurements indicate that neutron irradiation results in greater radiation hardening for specimens with larger oxygen concentration. Also, the further increase in strength upon post-irradiation annealing (radiation-anneal hardening) is enhanced by increasing oxygen content. It was concluded that the radiation-anneal hardening was caused by trapping of oxygen at the radiation-produced defect clusters. Similar behavior was exhibited by measurements of microhardness. Dissert. Abstr.

**N76-16213** Virginia Univ., Charlottesville.
**DUCTILE FRACTURE IN 304 STAINLESS STEEL ROLLED FOILS Ph.D. Thesis**
Robert William Bauer 1975 126 p
Avail: Univ. Microfilms Order No. 76-1093

Tensile specimens of polycrystalline 304 stainless steel, approximately 0.5 to 2 microns thick, were fractured in a HVEM by means of a hydraulically loaded tensile stage in order to study microstructural aspects of ductile fracture at the crack tip. Crack propagation occurred along or near <100> and was preceded by a local plastic zone. Holes were observed to initiate ahead of the crack tip at particles, twin and grain boundaries, as well as in clean areas of the tensile sample. Crack tip blunting was observed at both twin and grain boundaries. In order to relate these findings to ductile fracture behavior in bulk materials, the tensile properties of recrystallized foils in the thickness range 3.7 microns to 1.02 mm were determined. Fracture surfaces were subsequently examined by SEM. The yield stress increased 143 percent above the bulk value as the thickness decreased. This was accompanied by a decrease in ductility. Dissert. Abstr.

**N76-16214** Cincinnati Univ., Ohio.
**THE INFLUENCE OF SUBSTRUCTURE ON THE ELEVATED TEMPERATURE DEFORMATION OF AN AUSTENITIC ALLOY Ph.D. Thesis**
Ravindra Kumar Bhargava 1975 191 p
Avail: Univ. Microfilms Order No. 76-640

Transmission electron microscopy was used extensively to characterize the dislocation substructure that is developed in an austenitic stainless alloy (AISI 304 stainless steel) when tested in creep and tensile modes at elevated temperatures. The test temperatures varied from 538 C to 816 C. The test conditions of the specimens from the reference heat (9T2796) span a variation of strain rate or steady state creep rate from a low of 2.8 x 10 -10/sec to a high of 8.3 x 10 -2/sec. The stress values ranged from 3.52 kg/sq mm (5,000 psi) to 39.23 kg/sq mm (55,800 psi). In order to determine the development of dislocation substructure during the creep process, a special set of tests was performed on another heat (G8607) of AISI 304 stainless steel. These tests along with a few short time stress rupture tests were conducted at 704 C. Another series of creep tests on the specimens from the reference heat (9T2796) consisted of stress change experiments at 650 C. The stresses were reduced after allowing the specimens to creep into steady stage of creep at the original stresses. Dissert. Abstr.

**N76-16215** Cincinnati Univ., Ohio.
**HIGH TEMPERATURE FATIGUE SUBSTRUCTURE OF AUSTENITIC STAINLESS STEELS Ph.D. Thesis**
Hong Nahm 1975 192 p
Avail: Univ. Microfilms Order No. 76-725

Transmission electron microscopy was employed to study the fatigue substructure of Incoloy 800 and AISI 304 stainless steel at elevated temperatures. Substructure parameters such as cell or subgrain intercept size, dislocation density, and misorientation angle between adjacent cells or subgrains were evaluated and correlated with the observed fatigue properties. Incoloy 800 push-pull fatigue specimens were examined after being tested at various test conditions at 538, 649, 704 and 760 C. A special set of LCF experiments on AISI 304 stainless steel was performed in which each experiment was interrupted at different stages of fatigue life under a total strain range of 2% at 649 C. A comparison of fatigue properties and dislocation substructure was made in LCF of Incoloy 800 specimens tested in the push-pull and bend fatigue modes of deformation. Finally, the effect of the subboundary intercept size on room temperature mechanical properties was studied. Dissert. Abstr.

**N76-16216** Illinois Inst. of Tech., Chicago.
**STABILITY AND STRUCTURE OF RETAINED AUSTENITE IN A QUENCHED STAINLESS STEEL Ph.D. Thesis**
Anant Vishnu Samudra 1975 146 p
Avail: Univ. Microfilms Order No. 75-30016

A high-purity alloy of Fe-28Ni-0.1C was austenitized and quenched to a series of low temperatures (down to liquid helium temperature) to achieve different extents of martensitic transformation. Quantitative optical metallography and transmission electron microscopy were used to characterize the aspects of fragmentation of austenite and substructure of austenite. It is concluded that the stability of retained austenite is better explained by the compartment size effect than a work-hardening effect. Large austenite areas are less stable than small austenite areas, as shown by a requench experiment on a polished and etched sample examined by scanning electron microscope.
Dissert. Abstr.

**N76-16217#** Aeronautical Research Labs., Melbourne (Australia).
**ACOUSTIC EMISSION FROM THE MARTENSITIC TRANSFORMATION**
G. G. Martin May 1975 27 p refs
(ARL-Mat-Note-110) Avail: NTIS HC $4.00

The principles of acoustic and some of its uses were outlined. A review is given of the literature on the martensitic transformation with special attention to those transformations studied using acoustic emission. Results are given of further tests carried out to assess the suitability of an Fe-Ni alloy as a reference for

acoustic emission monitoring systems and the usefulness of acoustic emission as a research tool in the study of phase transformations. The high sensitivity to the martensitic start temperature (Ms) shown by acoustic emission requires a more accurate definition of (Ms). Author

**N76-16218#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**HEREDITARY EFFECTS IN THE DEFORMATION OF METALS**
Iu. N. Rabotnov and Iu. V. Suvorova 1975 8 p refs Transl. into ENGLISH from Nauka (Moscow), 1975 p 470-477
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

The problems of constructing governing equations for metals and describing their behavior under various conditions of deformation are considered. The transition from elastic to plastic strains is examined as well as the effects of the hereditary properties of the materials on the influence of the history of the strain process. Unloading and elastic-plastic wave propagation are also discussed. D.M.L.

**N76-16219*#** Kanner (Leo) Associates, Redwood City, Calif.
**HIGH TEMPERATURE CORROSION DURING COMBUSTION OF GAS, COAL AND OIL**
A. Rahmel Washington NASA Jan. 1976 20 p refs Transl. into ENGLISH from Werkstoffe Korrosion (West. Ger.), v. 16, no. 9, 1965 p 776-783
(Contract NASw-2790)
(NASA-TT-F-16870) Avail: NTIS HC $3.50 CSCL 11F

Mechanism of high temperature corrosion caused by combustion of gas, coal and oil is surveyed by literature. Fuels are subdivided into three groups according to their combustion products, namely, those free from sulfur and ashes, those containing sulfur but no ashes, and those containing both. Each of these groups is again divided by distinguishing between complete and incomplete combustion; most of data cited are for high temperature resistant steels. Author

**N76-16220*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OXIDE DISPERSION STRENGTHENED NICKEL PRODUCED BY NONREACTIVE MILLING**
Alan Arias Washington Jan. 1976 25 p refs
(NASA-TM-X-3331; E-8465) Avail: NTIS HC $3.50 CSCL 11F

It is shown that oxide dispersion strengthened alloys can be produced by a postulated nonreactive milling mechanism whereby the dispersoid is trapped at the interface between welding metal powder particles. This interparticle welding is possible because, without a suitable and sufficiently vigorous chemical reaction between the metal powder particles and the milling fluid, no protective, weld-preventing reaction coating is formed on these particles. Using water as the nonreactive milling fluid, Ni - 1.8-vol % thoria and Ni - 1.8-vol % yttria alloys with 1093 C tensile strengths ranging from 122.3 to 141.5 MN/sq m (17,900 to 20,500 psi) were produced by nonreactive milling. Author

**N76-16221#** Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
**MODEL PSEUDOPOTENTIALS AND ATOMIC PROPERTIES OF SIMPLE METALS AND ALLOYS Final Progress Report, 1 Aug. 1975**
D. O. Welch 1975 22 p refs
(Contract AT(30-1)-4198)
(COO-3446-1) Avail: NTIS HC $3.50

A theoretical investigation was made of impurity-vacancy binding and impurity diffusion by the mechanism of vacancy motion. Calculations were made of the impurity-vacancy binding energy and impurity migration energy in simple metals using model pseudopotentials. Several model potentials and dielectric functions were used and the sensitivity of the results to the parameters of the models explored. NSA

**N76-16222#** Hanford Engineering Development Lab., Richland, Wash.
**HEAVY SECTION STEEL TECHNOLOGY PROGRAM. THE IRRADIATED FRACTURE TOUGHNESS OF ASTM A533, GRADE B, CLASS 1 STEEL MEASURED WITH A FOUR INCH THICK COMPACT TENSION SPECIMEN**
J. A. Williams Jan. 1975 30 p refs
(Contract AT(45-1)-2170)
(HEDL-TME-75-10; TR-36) Avail: NTIS HC $4.00

The fracture toughness of an ASTM A533-B four inch thick compact tension specimen irradiated at 550 F was determined to be 80 ksi root in. at a test temperature of 200 F. Smaller 0.394 inch thick fracture specimens were tested prior to the large specimen test to aid in establishing the test temperature and to compare the fracture transition of large and small irradiated specimens. The K/sub Ic.394/ toughness transition as measured at 100 ksi root in. was observed at a temperature of 210 F; plate RW and WR orientations were comparable. Fracture toughness behavior of the small specimens closely predicts the large specimen behavior in the transition region, 23 references. Author (NSA)

**N76-16223#** Pittsburgh Univ., Pa. Dept. of Chemistry.
**THERMAL, STRUCTURAL AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS Annual Report, 15 May 1974 - 15 May 1975**
W. E. Wallace and V. U. S. Rao -1 Jun. 1975 59 p refs
(Contract E(11-1)-3429)
(COO-3429-26) Avail: NTIS HC $4.50

The odd magnetic properties of Y6(Fe/sub 1-x/Mn/sub x/)23 ternaries were studied. Magnetic studies of Th(Co/sub 1-x/Ni/sub x/)5 ternaries show strong magnetic anisotropy in ThCo5 originates with the Co in the 2c sites. Efforts were made to effect a change of coupling in rare earth-transition metal systems, using alloys doped with Ca or Ag to lower electron concentration. Numerous ternaries of the formula RT2X2 were prepared and studied magnetically. Magnetic properties of various Yb-Co binaries were determined. Heat capacity data on Dy3Al2 and DyNiCo are reported. Hydrogen absorption and desorption studies on the RT3 systems (T equals Fe or Co) and on Tb2Co7 were made at several temperatures. From the temperature coefficient of these measurements the heats of solution were determined. These range from about 9 to 10 kcal per mole of hydrogen. Pulsed field gradient NMR equipment has been readied to determine the mobility of H in rare earth intermetallics. NSA

**N76-16224#** Los Alamos Scientific Lab., N.Mex.
**THERMAL AND OTHER PROPERTIES OF REFRACTORIES**
D. T. Vier Apr. 1975 51 p refs Sponsored by ERDA
(Contract W-7405-eng-36)
(LA-5937-MS) Avail: NTIS HC $5.45

A semi-theoretical treatment was presented that allows a rapid estimate of high-temperature enthalpies and the enthalpies of vaporization and fusion of refractory materials. This treatment gives the enthalpy H of a refractory solid at its melting point to be (25)(n)(TM)/(FW), where n is the number of atoms per formula weight FW, and TM is the melting point in degrees K. The heat of fusion is about 0.4 times the enthalpy at the melting point, and the heat of vaporization at the boiling point is about (7.6)(k)(H)/(n), where k is the number of moles of gas formed by one FW of the material. Formulas were also given for the enthalpies of the liquid and vapor at the melting point in terms of H. Selected data on 17 properties of approximately 500 refractories were tabulated. NSA

**N76-16225#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Materials Engineering.
**THE INFLUENCE OF GROWTH RATE AND TEMPERATURE ON HIGH CYCLE FATIGUE OF Al-Al3Ni**
G. E. Maurer, D. J. Duquette, and N. S. Stoloff 1 Aug. 1975 32 p refs
(Contract N00014-75-C-0503; NR Proj. 031-745)
(AD-A014602) Avail: NTIS CSCL 11/6

High-cycle fatigue tests have been conducted on specimens of an Al-Al3Ni eutectic alloy, unidirectionally solidified at selected rates from 0.5cm/hr to 1200cm/hr. Tests were conducted in air at 298K98K, 458K and 683K. Room temperature fatigue lives were independent of growth rate at low solidification rates but were markedly improved in samples grown at 1200cm/hr. The dependence of fatigue life on growth rate at elevated temperatures appears to be due primarily to differences in cyclic creep rates as a result of varying interfiber spacings. Crack

initiation and propagation mechanisms were established by metallographic and fractographic examination. Dislocation substructure-fiber interactions were studied by transmission electron microscopy. GRA

**N76-16226#** British Steel Corp., Sheffield (England). Information Services.
**THE EFFECT OF RAW MATERIALS FOR STEELMAKING ON ENERGY REQUIREMENTS**
D. I. T. Williams and D. S. Thornton Aug. 1975 22 p
(PB-245058/3; CAPL-SM/A/14/75) Avail: NTIS HC $3.50 CSCL 11F

The value of raw materials used in steelmaking is influenced by the impurities present, the grade of steel made, and the steelmaking process employed. It is important that the maximum benefits are derived from the available raw materials, for considerations of both economics and conservation of resources. The major factors affecting the energy requirements of the process routes are examined in an attempt to highlight where maximum benefits can be achieved. The presence of contaminants adhering to iron and scrap can increase the thermal requirements by significant amounts, thereby adding to the fuel costs in steelmaking. GRA

**N76-16227#** Battelle Columbus Labs., Ohio.
**STUDY OF THE ENERGY AND FUEL-USE PATTERNS IN THE NONFERROUS METALS INDUSTRIES**
E. H. Hall, E. S. Bartlett, F. H. Buttner, H. N. Conkle, D. C. Drennen et al 31 Dec. 1974 356 p refs
(Contract DI-14-01-0001-1658)
(PB-245194/6; FEA/EI-1658) Avail: NTIS HC $10.50 CSCL 11F

The patterns of energy use in 10 SIC's within the nonferrous metals industries are covered. Total energy use, broken down by fuel type, is estimated for each of the 10 industries and for major processes within each industry. A review of each industry is presented with respect to: the potential for fuel switching, opportunities for short-term conservation, sources of fuels and energy supply, levels of fuel stocks, key constraints on industry operations, and industry products which may be critical to the needs of Project Independence. GRA

# 27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

**N76-16228*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**UTILIZATION OF OXYGEN DIFLUORIDE FOR SYNTHESES OF FLUOROPOLYMERS Patent**
Madeline S. Toy, inventor (to NASA) (McDonnell-Douglas Corp., Santa Monica, Calif.) Issued 6 Jan. 1976 11 p Filed 11 Jun. 1970 Supersedes N72-21100 (10 - 12, p 1566) Sponsored by NASA
(NASA-Case-NPO-12061-1; US-Patent-3,931,132;
US-Patent-Appl-SN-45549; US-Patent-Class-260-92.1;
US-Patent-Class-260-879; US-Patent-Class-260-900) Avail: US Patent Office CSCL 07C

The reaction oxygen difluoride, OF2, with ethylenically unsaturated fluorocarbon compounds is examined. Depending upon the fluorocarbon material and reaction conditions, OF2 can chain extend fluoropolyenes, convert functional perfluorovinyl groups to acyl fluoride and/or epoxide groups, and act as a monomer for an addition type copolymerization with diolefins.
Official Gazette of the U.S. Patent Office

**N76-16229*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**FUSED SILICIDE COATINGS CONTAINING DISCRETE PARTICLES FOR PROTECTING NIOBIUM ALLOYS Patent**
Salvatore J. Grisaffe and Stanley R. Levine, inventors (to NASA) Issued 6 Jan. 1976 4 p Filed 4 May 1973 Supersedes N73-22474 (11 - 13, p 1540)
(NASA-Case-LEW-11179-1; US-Patent-3,931,447;
US-Patent-Appl-SN-357312; US-Patent-Class-428-450;
US-Patent-Class-29-195A; US-Patent-Class-427-203;
US-Patent-Class-427-204; US-Patent-Class-427-205;
US-Patent-Class-427-270; US-Patent-Class-427-275;
US-Patent-Class-427-287; US-Patent-Class-428-457;
US-Patent-Class-428-469; US-Patent-Class-428-539) Avail: US Patent Office CSCL 11G

Fused silicide coatings for protecting niobium alloy substrates are modified by providing dispersed nucleation sites in the form of discrete particles in the coating. The discrete particles have a thermal expansion coefficient lower than that of the fused silicide material. This alters the microstructure and reduces the thermal expansion coefficient of the coating so as to minimize the number of tensile cracks. Official Gazette of the U.S. Patent Office

**N76-16230*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**TRANSPARENT FIRE RESISTANT POLYMERIC STRUCTURES Patent**
George M. Fohlen, John A. Parker, and Paul M. Sawko, inventors (to NASA) Issued 23 Dec. 1975 8 p Filed 29 Jan. 1974 Supersedes N74-16249 (12 - 07, p 0812)
(NASA-Case-ARC-10813-1; US-Patent-3,928,708;
US-Patent-Appl-SN-437556; US-Patent-Class-428-412;
US-Patent-Class-264-331; US-Patent-Class-428-413;
US-Patent-Class-428-447; US-Patent-Class-428-920;
US-Patent-Class-428-921; US-Patent-Class-428-911) Avail: US Patent Office CSCL 11D

Transparent impact-, heat- and fire-resistant polymeric materials for making windows, windshields and plane canopies are provided; the polymeric materials comprise and exposy resin cured with an alkoxy boroxine catalyst and a polycarbonate resin, preferably a polyphenolphthalein carbonate resin. The laminates, including the advantages of both resins, comprise a transparent layer of epoxy resin and a transparent layer of a polycarbonate resin joined together with a transparent adhesive interlayer.
Official Gazette of the U.S. Patent Office

**N76-16231** Connecticut Univ., Storrs.
**THERMAL OPTICAL ANALYSIS AND MICROSTRUCTURAL CHARACTERIZATION OF POLYMERS Ph.D. Thesis**
John Albert Reffner 1975 146 p
Avail: Univ. Microfilms Order No. 76-1703

A micro thermal optical analysis system for measurement of transmitted light intensity as a function of temperature was assembled and evaluated quantitatively for polarized light (DLI) and non-polarized axial transmitted intensity (ATI). It is possible to quantitatively relate DLI measurements to polymer crystallinity when cross-circularly polarized light is used, retardations are less than 275 nm, materials are nonabsorbing, low light scattering and stress and form birefringence are minimized. Chemically crosslinked polyethylene is used as a model system for DLI measurements. A survey of the literature on DLI is included. The transmitted light intensity, as a function of temperature for non-polarized, low aperture (axial) incident light (ATI) is related to the scattering of light by the material. Results of ATI compliment DLI observations. The microstructure of chemically crosslinked polyethylene was also investigated. Dissert. Abstr.

**N76-16232** California Univ., Los Angeles.
**THE STRENGTH OF BRITTLE CERAMICS IN COMPRESSIVE STRESS STATES Ph.D. Thesis**
Marc Arnold Adams 1975 306 p
Avail: Univ. Microfilms Order No. 76-819

A mechanical testing program in which the biaxial compressive strength of WESGO AL-995, high strength alumina was measured has shown that the biaxial compressive strength of such material is only slightly affected by the value of the intermediate principal compressive stress. The average value of the compressive strengths measured in all stress states, excluding the equi-biaxial compression stress state, was 528 ksi. The standard deviation of the individual measured strengths was only a few percent of the average values which is consistent with the predictions of flaw statistics theories. The tensile strengths measured for the material indicate the ratio of compressive strength to tensile strength is approximately 18. The design and operation of the various testing devices employed is described. Problems were encountered in the equi-biaxial compression stress state tests.

These problems and the general problem of performing valid compressive strength measurements are discussed.
Dissert. Abstr.

**N76-16233** Northwestern Univ., Evanston, Ill.
**DIGITAL MONITORING AND ESTIMATION OF POLYMERIZATION REACTORS Ph.D. Thesis**
Jae Hyun Jo 1975 87 p
Avail: Univ. Microfilms Order No. 75-29667

A Kalman filter was applied in the polymerization of vinyl acetate in a continuous-stirred-tank-reactor to estimate conversion, weight-average molecular weight and other parameters. Several variants of the filter were tested with different combinations of covariance matrices and parameters. The estimates from the filter were compared with the results obtained through sample analysis. It was observed that using the proper ratio of the norms of the process and measurement noise covariance matrices is an important factor in determining the filter performance. The effect of the initial-estimate covariance matrix on the filter performance was not significant. Using adaptive, exponential, or iterative schemes did not improve the filter performance in view of the relatively long residence time. Thus, the assumption of steady state dynamic equations produced a similar result to that with the full set of dynamic equations. Dissert. Abstr.

**N76-16234** Northwestern Univ., Evanston, Ill.
**BIODEGRADATION OF SEMI-CRYSTALLINE POLYMERS Ph.D. Thesis**
Steven Arthur Bradley 1975 232 p
Avail: Univ. Microfilms Order No. 75-29582

The basic principles governing the initial stages of microbial degradation of semi-crystalline polymer solids are identified. Regenerated cellulose (cellophane), solutioncast amylose, and hot pressed polycaprolactone films were selected as a model biodegradable polymers, with the deterioration process monitored by X-ray diffraction, infrared spectroscopy, mechanical property, electron microscopy, and dynamic mechanical measurements. Specimens were subjected to fungal and cell-free enzymatic hydrolysis, and the effects of physical or chemical modifications on the ensuing microbial degradation processes were examined. Dynamic mechanical properties of polysaccharides were also studied in terms of alterations of the mechanical couplings between structural units in these solids due to fungal attack.
Dissert. Abstr.

**N76-16235#** Royal Aircraft Establishment, Farnborough (England).
**THE EFFECT OF BULKY CYCLIC SIDE GROUPS ON THE HEAT RESISTANCE OF CARBOCHAIN POLYMERS**
V. V. Korshak, S. N. Salazkin, S. V. Vinogradova, G. L. Slonimskii, A. A. Askadskii, G. Sh. Chelidze, K. A. Bychko, and L. I. Kamarova Sep. 1975 7 p refs Transl. into ENGLISH from Vysokomolekul. Soedin. (USSR), v. B13, no. 2, 1971 p 150-152
(RAE-Lib-Trans-1869; BR49821) Avail: NTIS HC $3.50

Copolymers of methylidine phthalide with styrene, acrylonitrile, and methyl methacrylate are reported. Measurement of their glass transition temperatures (t sub g s) by thermomechanical and dynamic mechanical techniques leads to an extrapolated value for the T sub g of poly(methylidine phthalide) of 370 to 380 C. The introduction of phthalide groups into carbon-chain polymers so that part of the ring lies in the main chain leads to a sharp increase in heat resistance. Author

**N76-16236*#** Miami Univ., Coral Gables, Fla. Inst. for Molecular and Cellular Evolution.
**LINKAGES IN THERMAL COPOLYMERS OF LYSINE**
Sidney W. Fox and Fusae Suzuki [1975] 11 p refs Submitted for publication
(Grant NGR-10-007-008)
(NASA-CR-146145) Avail: NTIS HC $3.50 CSCL 07C

The thermal copolymerization of lysine with other alpha-amino acids was studied. The identity of the second amino acid influences various properties of the polymer obtained, including the proportion of alpha and epsilon linkages of lysine. A review of linkages in proteinoids indicates alpha and beta linkages for aspartic acid, alpha and gamma linkages for glutamic acid, alpha and epsilon linkages for lysine, and alpha linkages for other amino acids. Thermal proteinoids are thus more complex in types of linkage than are proteins. Author

**N76-16237*#** TRW Systems Group, Redondo Beach, Calif.
**DEVELOPMENT OF AUTOCLAVE MOLDABLE ADDITION-TYPE POLYIMIDES Final Report, 12 Jun. 1974 - 30 Sep. 1975**
R. W. Vaughan, R. J. Jones, M. K. ORell, and G. A. Zakrzewski Jan. 1976 46 p refs
(Contract NAS3-17824)
(NASA-CR-134900; TRW-26446-6015-RU-00) Avail: NTIS HC $4.00 CSCL 11G

Chemistry and processing modifications of the poly(Diels Alder) polyimide (PDA) resin were performed to obtain structural composites suitable for 589 K (600 F) service. This work demonstrated that the PDA resin formulation is suitable for service at 589 K (600 F) for up to 125 hours when used in combination with Hercules HTS graphite fiber. Sandwich panels were autoclave molded using PDA/HTS skins and polyimide/glass honeycomb core. Excellent adhesion between honeycomb core and the facing skins was demonstrated. Fabrication ease was demonstrated by autoclave molding three-quarter scale YF-12 wing panels. Author

**N76-16238#** Sandia Labs., Albuquerque, N.Mex.
**MECHANICAL PROPERTIES OF MOLYBDENUM-SEALING GLASS-CERAMICS**
J. C. Swearengen and R. J. Eagan Jul. 1975 36 p refs
(Contract AT(29-1)-789)
(SAND-75-0346) Avail: NTIS HC $4.00

Elastic constants, thermal expansion, strength, and fracture toughness were determined for a molybdenum-sealing glass-ceramic containing approximately 31 volume percent $Zn_2SiO_4$ crystals in a glass matrix. The microstructure was studied for two different crystallization treatments and moderate changes in composition. Mechanical properties of the composite were compared with the properties of the constituent phases through application of mixture theory and by fractographic observations. The reinforcing effects of the crystal phase at room temperature are evident in comparison with the properties of the residual glass but not necessarily in comparison with the parent glass. Fracture toughness of the composite depends primarily upon additive properties of the separate phases instead of by interactive effects such as microcracks. Author (NSA)

**N76-16239#** Delft Hydraulics Lab. (Netherlands).
**INVESTIGATIONS ON THE HYDRAULIC CHARACTERISTICS OF SYNTHETIC FABRICS**
H. J. M. Ogink May 1975 45 p refs
(Publ-146) Avail: NTIS HC $4.00

Characteristic properties of fabric used to protect sand bodies were determined. Properties studied were pore size, water permeability, sand tightness under static or dynamic loads and blocking of the following fabric types: mesh nettings, tape fabrics, mats, multifilament fabrics, and non wovens. The results of the measurements were analyzed. ESA

**N76-16240#** British Steel Corp., Sheffield (England). Information Services.
**THE DEVELOPMENT AND TESTING OF A NOVEL HIGH TEMPERATURE CERAMIC RECUPERATOR**
W. R. Laws, W. R. Laws, H. R. McChesney, D. A. Winkworth, and E. Morris Aug. 1975 21 p refs
(PB-245059/1; CEL/CE/14/75) Avail: NTIS HC $3.50 CSCL 13A

Energy Consumption in a large integrated steelworks is described. Large quantities of energy are lost in the form of high-temperature thermal effluents, even from plants where waste heat recovery is already practiced. A short survey of traditional designs of ceramic and metallic recuperators highlights performance limitations of existing plant. The development of a new design of ceramic recuperator for operating with waste gas temperatures of up to 1300C is described. The development program, is briefly mentioned referring to theoretical computer model studies and the testing of components. The design of a prototype ceramic recuperator for an oil-fired soaking pit is described and perliminary results given. Potential applications are discussed. GRA

# 28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**N76-16241*#** National Aeronautics and Space Administration. Pasadena Office, Calif.
**IMPROVED HYDROGEN-RICH GAS GENERATOR Patent Application**
John Houseman, inventor (to NASA) (Calif. Inst. of Tech., Pasadena) Filed 27 Dec. 1975 22 p Sponsored by NASA (NASA-Case-NPO-13464-2; US-Patent-Appl-SN-553687) Avail: NTIS HC $3.50 CSCL 21D

A process and apparatus are described for producing a hydrogen rich gas from liquid hydrocarbon and water using the partial oxidation steam reforming process. NASA

**N76-16242#** Wells (Franklin B.), Memphis, Tenn.
**DEVELOPMENT OF A NONPROPRIETARY FLEXIBLE SHEET EXPLOSIVE**
Franklin B. Wells Jul. 1975 51 p refs
(Contract DAHC04-72-A-0001)
(AD-A015047; PA-TR-4714) Avail: NTIS CSCL 19/1

A nonproprietary, olive-drab colored, flexible sheet explosive based on cyclotrimethylenetrinitramine (RDX) was developed as a replacement for a pentaerythritol tetranitrate (PETN) based flexible sheet explosive (EL 506C, Type II) manufactured under U.S. Patent No. 2,992,087 by E. I. DuPont. Before completion of the program, the study was expanded to include flexible explosive compositions based on cyclotetramethylenetetranitramine (HMX) and mixtures of RDX and HMX. GRA

**N76-16243#** Dynatech R/D Co., Cambridge, Mass.
**FUEL GAS PRODUCTION FROM SOLID WASTE Final Rpeort, 28 Jun. 1973 - 31 Dec. 1974**
R. G. Kispert, S. E. Sadek, L. C. Anderson, and D. L. Wise 31 Jan. 1975 167 p refs
(Contract NSF C-827)
(PB-245083/1; Dynatech-1258; NSF/RA/N-74/268) Avail: NTIS HC $6.75 CSCL 21D

Six major program tasks are discussed: (1) preliminary engineering analysis and economic evaluation of a full-scale fuel gas from solid waste facility; (2) pilot plant design, procurement, and initial operation; (3) supporting laboratory experiments and studies at the University of Massachusetts and M.I.T.; (4) confirmation of the economic model for the full-scale fuel gas from solid waste facility; (5) evaluation and specification of a proof-of-concept pilot plant; and (6) application of the computer model to full-scale plant studies. GRA

**N76-16244#** Exxon Research and Engineering Co., Linden, N.J. Government Research Lab.
**FUTURE SYNTHETIC FUELS: A SCIENTIFIC AND TECHNICAL APPLICATIONS FORECAST Final Report**
William F. Taylor and Homer T. Hall Sep. 1975 152 p refs
(Contract DAAD05-73-C-0559)
(AD-A014947) Avail: NTIS CSCL 21/4

This STAF reviews the broad problem of the impact on the U.S. Army of the use of synthetic fuels (defined as a non-petroleum derived fuel) over the time period of 1975 to 2000. The STAF is divided into three basic parts. The first part involves a forecast of which synthetic fuels will have a major impact in the time period under study. In the second part of the STAF, those alternate fuels identified as the most feasible synthetic fuels in the future were subjected to detailed analyses. The third part of the STAF consists of the identification of a number of areas which appear to offer promise for fruitful R and D in the synthetic fuel area. Author (GRA)

# 31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

**N76-16245*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**INSULATION FOR PIPING Patent Application**
Guillermo Lerma, inventor (to NASA) (Rockwell Intern. Corp., Downey, Calif.) Filed 23 Dec. 1975 14 p
(Contract NAS9-14000)
(NASA-Case-MSC-19523-1; US-Patent-Appl-SN-643895) Avail: NTIS HC $3.50 CSCL 11G

A foamed insulation for cryogenic pipe lines comprised of a pair of preformed, semicircular foamed insulation half-sections is described. The faying surfaces are coated with a polyurethane adhesive and bonded together about the pipe. The faying surfaces of the pipe and inner radii of the half-sections are not bonded together. The ends of the foamed insulation half-sections are tapered and a knitted outer material is stretched over the pipe, the tapered ends, and the body of the mated half-sections and extends over the pipe beyond each tapered end. A polyurethane resin coating is applied to the knitted outer material to form a seal and prevent air circulation through the half-sections and provide abrasion resistance. A process of insulating a cryogenic pipe line and a process for forming the preformed insulation half-sections is also described. NASA

**N76-16246#** Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
**ESTIMATED HYDRODYNAMIC STRUT SIDE FORCES ON A 200-TON 80 KNOT HYDROFOIL CRAFT Interim Report**
Edwin P. Rood, Jr. Oct. 1974 64 p refs
(ZF43421001)
(AD-A014874; SPD-584-01) Avail: NTIS CSCL 13/10

Estimates of expected hydrodynamic loadings on the struts of 80-knot hydrofoil craft are required for the structural design of such craft. An effort was made to provide the needed design data by considering both the maximum side force on a strut not experiencing side ventilation, and the side force required to perform flat turns in a certain sea state. GRA

**N76-16247#** Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
**TURNING MANEUVER LIMITATIONS IMPOSED BY SUDDEN STRUT SIDE VENTILATION ON A 200-TON 80-KNOT HYDROFOIL CRAFT Final Report**
Edwin P. Rood, Jr. May 1975 56 p refs
(ZF43421001)
(AD-A014875; SPD-584-02) Avail: NTIS CSCL 13/10

Predictions of turning characteristics of an 80-knot hydrofoil craft performing ordinary coordinated turns indicate that, in principle, sudden strut side ventilation will limit craft maneuverability only if large turning rates are attempted in a seaway. A six-degree-of-freedom computerized simulation of a 200-ton craft performing coordinated turns in calm water indicated no danger of sudden strut side ventilation providing the control system is properly tuned to produce essentially zero strut yaw angles with respect to the flow at the maximum craft speed. GRA

**N76-16248#** Naval Research Lab., Washington, D.C. Cryogenics and Superconductivity Branch.
**EVALUATION OF A 4.5-K CLOSED-CYCLE REFRIGERATOR Final Report**
John E. Cox Jul. 1975 30 p refs
(NRL Proj. P05-04; RR0111101)
(AD-A015308; NRL-MR-3088) Avail: NTIS CSCL 13/1

Superconducting devices require ambient temperatures in the 4 to 15 K region. Unattended operation for periods of days to weeks require either large dewar systems or closed cycle refrigerators. The report describes the magnetic and vibration signatures below 500 Hz of one refrigerator, a 4.5 K superposition of a CTi 1020 Cryodine with a Joule-Thomson expansion valve. User comments are included in the discussion with the conclusion being that closed cycle refrigerators are unlikely to be compatible with Josephson detector devices, but interfacing

with superconducting coils and cavities is not definitively ruled out. GRA

# 32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

**N76-16249*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**LOW DISTORTION RECEIVER FOR BI-LEVEL BASEBAND PCM WAVEFORMS Patent**

George E. Proch, inventor (to NASA) (Lockheed Electronics Co., Inc., Houston, Tex.) Issued 2 Dec. 1975 10 p Filed 26 Apr. 1974 Continuation-in-part of US Patent Appl. SN-428994, filed 27 Dec. 1973 Sponsored by NASA

(NASA-Case-MSC-14557-1; US-Patent-3,924,068; US-Patent-Appl-SN-464720; US-Patent-Class-178-88; US-Patent-Class-178-69C; US-Patent-Class-325.321; US-Patent-Appl-SN-428994) Avail: US Patent Office CSCL 17B

An improved low distortion asynchronous receiver, designed to receive balanced differential signals from a transmission line, recover and reconstruct a positive logic level signal from the received signals, and supply a suitable unipolar pulse code modulated (pcm) output waveform to a conventional sync detector/data decoder for further processing is disclosed. A hybrid transformer couples the differential signals appearing on the transmission line into the receiver as a double-ended input referenced to the receiver ground. Each of the two signals is applied to a separate low pass filter network to provide a standard waveform transition characteristic. Each filtered signal is supplied to a threshold detection circuit comprising a differential comparator, a NAND gate and a voltage divider network. The detection circuit provides a stable threshold level for converting the filtered line signal to positive logic levels.

Official Gazette of the U.S. Patent Office

**N76-16250** British Broadcasting Corp., Kingswood (England). Research Dept.

**A FIELD STRENGTH MEASURING RECEIVER FOR BAND 2**

D. G. Beadle and J. A. Fox Nov. 1975 10 p refs

(BBC-RD-1975/33) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A receiver was designed for the investigation of reception conditions for both monophonic and stereophonic broadcasts using the pilot tone stereo system in the band 87 to MHZ. The design was intended to replace two earlier receivers and, in addition, provided commercial quality stereo reception for assessment of the stereo service provided in any area. These requirements are somewhat conflicting and the resultant design described was therefore a compromise. It is possible that extensive field use may lead to a reconsideration of this compromise. To meet this possibility the receiver was made in modular form. Author

**N76-16251** Polytechnic Inst. of New York.

**WIDE-ANGLE WIDE-BAND ELEMENTS FOR PHASED ARRAYS Ph.D. Thesis**

Shii-shyong Wang 1975 167 p

Avail: Univ. Microfilms Order No. 75-21409

A step-by-step approach toward improved wideangle wideband performance of a planar rectangular waveguide array by separately introducing a transition element for wide angle scan and a ridged waveguide element for wide band operation is outlined. A merger of the two elements is then proposed for combined wideangle wideband performance. The transition element examined here employs the concept of a tapered transmission line which causes the output load impedance to be matched to the input impedance. A V-cut is made in the E- or H-plane walls of rectangular waveguide element array to implement the idea with the object of approaching a perfect impedance matching over entire E- or H-plane scan respectively. The experimental results show that the transition element does indeed eliminate the large impedance mismatch associated with end fire grating lobes, with as short as half-guide-wavelength V-cuts. Dissert. Abstr.

**N76-16252** Illinois Univ., Urbana.

**REMOTE SENSING OF THE MESOSPHERE USING THE JICAMARCA INCOHERENT-SCATTER RADAR Ph.D. Thesis**

Prabhat Kumar Rastogi 1975 262 p

Avail: Univ. Microfilms Order No. 75-24387

Backscatter observations of the mesosphere using the 50 MHz incoherent-scatter radar at Jicamarca, Peru are reported and analyzed. It is shown that the scattering is affected by the properties of the medium at two widely separated scales: (1) those in the vicinity of the scale of the Bragg vector, and (2) those larger than the dimensions of the scattering volume. Oscillations in the observed mesospheric velocities are shown to be a manifestation of mesospheric gravity waves of periods > 4-min. to periods > 1 hr. It is shown that the dominant-internal gravity wave of approximately 15 - min. period vertically evanescent and have a horizontal wavelength of a few hundred km. The observed intermittency of echo power is shown to be a consequence of intermittent mesospheric turbulence. It is shown that turbulence in the mesosphere occurs in the form of thin horizontal layers which have a minimum thickness of several tens of meters and a horizontal size of several tens of km.

Dissert. Abstr.

**N76-16253** Iowa State Univ. of Science and Technology, Ames.

**A NEW ADAPTIVE DELTA MODULATION SYSTEM Ph.D. Thesis**

Hyun-Jik Kim 1975 85 p

Avail: Univ. Microfilms Order No. 76-1851

A hybrid (combination of analog and discrete) adaptive delta modulation system which adapts its step sizes instantaneously based on n previous bits was proposed, implemented (for n = 4 plus 4 more sequences), and tested with a performance criterion on S/N for 800 Hz sinusoidal waveforms. With a low-pass filter in the feedback loop, the adaptive technique in the system can be regarded as a combination of a syllabic companding technique of a continuous ADM and an instantaneous companding technique of a discrete ADM. The blend of the two techniques is a function of the cutoff frequency of the filter. After the order of the possible sequence from the shift register was derived, partly using Jayant's approach, the step sizes were experimentally determined by choosing the best of the three quantizers tried. The low-pass filter inserted in the feedback loop of the system to smooth out abrupt variations in the step sizes was found to improve the system performance significantly. The low-pass filter did cause slight degradation in the slope overload region. Dissert. Abstr.

**N76-16254** Kansas Univ., Lawrence.

**IMAGE ORIENTED ANALYSIS OF THE SYNTHETIC APERTURE RADAR SYSTEM Ph.D. Thesis**

Fred McCartney Dickey 1975 103 p

Avail: Univ. Microfilms Order No. 75-30020

A theory is developed of the synthetic aperture radar system that relates the image at the output of the system to the radar target being sensed. The result of the analysis is a unique mathematical description or transfer function of the radar system. The analysis is done in terms of the general characteristics of the synthetic aperture radar system without undue attention to the hardware aspects of the problem. The form of the mathematical description of the radar system suggests a unique and simple method of simulating synthetic aperture radar imagery. Simulated radar images were produced using coherent optical techniques to realize the mathematics of the system transfer function. The simulated images qualitatively support the validity of the theory. Another important aspect of the synthetic aperture radar image is the potentially large dynamic range. It is shown that the dynamic range of the radar image may be greater than 60 db.

Dissert. Abstr.

**N76-16255#** Royal Aircraft Establishment, Farnborough (England).

**THE USE OF TELEMETRY AND TELECOMMAND EQUIPMENT IN MEASURING TECHNIQUES FOR RESCUE AND**

**RECOVERY STEMS**
H. J. Klewe Oct. 1975 36 p refs Transl. into ENGLISH from Deut. Luft- und Raumfahrt DLR Mitt. (West Germany), 1974
(RAE-Lib-Trans-1853; BR50017) Avail: NTIS HC $4.00

A survey is given of measuring techniques applied in rescue and recovery systems, with special reference to the use of telemetry and telecommand equipment. Measuring and test installations are described such as instrumented test vehicles, dummies, and measuring equipment for parachutists. The essential ground equipment, like telemetry and telecommand installations, as well as the telemetry and telecommand procedures, are also described. Reference is made to a test installation for testing model parachutes in free flight and to the measuring technique used in this case. Author

**N76-16256#** Advisory Group for Aerospace Research and Development, Paris (France).
**ELECTROMAGNETIC NOISE INTERFERENCE AND COMPATIBILITY**
Nov. 1975 585 p refs In ENGLISH and FRENCH Presented at the Joint Avionics/Electromagnetic Wave Propagation Panels Symp., Paris, 21-25 Oct. 1974
(AGARD-CP-159) Avail: NTIS HC $13.75

Electromagnetic interference and compatibility studies on avionics equipment and subsystems are presented. For individual titles, see N76-16257 through N76-16297.

**N76-16257** Stanford Research Inst., Arlington, Va.
**DEFINITIONS AND FUNDAMENTALS OF ELECTROMAGNETIC NOISE, INTERFERENCE, AND COMPATIBILITY**
G. H. Hagn *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 24 p refs (For availability see N76-16256 07-32)

The terms electromagnetic noise, interference, and compatibility are defined, and some of the different definitions for these terms in current usage are discussed with emphasis on international definitions. For this paper, noise is defined as all electromagnetic energy except that associated with the desired signal for a specific system of interest. Interference is considered to be an undesirable effect of electromagnetic noise upon a system or subsystem rather than as a cause or source of noise. Electromagnetic compatibility is the condition that prevails when telecommunications equipment is collectively performing its individually assigned functions in a common electromagnetic environment without causing or suffering unacceptable interference. Selected aspects of the fundamentals of noise, interference, and compatibility are discussed. Author

**N76-16258** Lightning and Transients Research Inst., Melbourne, Fla.
**ATMOSPHERIC DISCHARGES AND NOISE (AND COMMUNICATIONS SYSTEMS INTERFERENCE REDUCTION)**
M. M. Newman and J. D. Robb *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 22 p refs (For availability see N76-16256 07-32)

Most studies of atmospherics in the past have dealt with the subject on the basis of the frequency domain as a linear phenomenon. From the special point of view of working to improve communications systems performance, there are advantages to be derived in viewing the problem in the time domain. Considered are broadband measurements, up to 200 megaherz, of the fine structure of radiation from individual discharges, as well as longer consecutive records of the character and spacing of pulse components of branching streamers and repeated discharges, which have hitherto been unavailable. Direct lightning interception studies are discussed in relation to discharge noise characteristics. Research on artificial lightning discharge noise propagation and reception at various distances is presented as a unique tool for atmospherics propagation studies. Author

**N76-16259** Stanford Research Inst., Arlington, Va.
**MAN-MADE ELECTROMAGNETIC NOISE FROM UNINTENTIONAL RADIATORS: A SUMMARY**
G. H. Hagn and R. A. Shepherd *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 24 p refs (For availability see N76-16256 07-32)

Considered is the noise from electrical and electromechanical devices that are not designed as intentional radiators but that produce electromagnetic energy as a by-product. The emphasis here is on description of the noise from electrical power transmission and distribution lines and from vehicle ignition systems; these two sources are known to be important below and above 20 MHz, respectively. Other sources are mentioned, and prediction of the composite environment due to unintentional radiators is considered. Author

**N76-16260** Observatoire de Paris-Meudon (France).
**COSMIC NOISE [LES BRUITS COSMIQUES]**
A. Boischot *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 12 p refs In FRENCH (For availability see N76-16256 07-32)

A description of the various natural sources of electromagnetic radio noise was given, including the nature of the various types of noise generated. Some of these have a very broad, continuous spectrum (such as the noise from galaxies or radio sources), while others have intermittent, irregular spectra (such as the noise from solar or Jovian flares, pulsars). The average characteristics of the various parts of the spectra generated by these sources were given, including their perturbing effects on ground communication. Transl. by Y.J.A.

**N76-16261** Science Research Council, Slough (England). Appleton Lab.
**LAND, SEA AND ATMOSPHERIC THERMAL NOISE**
P. G. Davies *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 15 p refs (For availability see N76-16256 07-32)

Thermal emission is reviewed for the natural environment within the microwave, far infrared and medium infrared bands of the E-M spectrum down to a wavelength of about 3 micron where reflection of solar radiation begins to predominate. The emphasis is primarily on the fundamental aspects of the emissive properties of the atmosphere and various surfaces and the relationship of this thermal emission to the thermal, absorptive and scattering properties of the atmosphere in slant path propagation. A nomogram technique for determining the noise signal at a point in the atmosphere is considered and a bibliography of recent work on thermal emission is included. Author

**N76-16262*** Stanford Research Inst., Menlo Park, Calif. Radio Physics Lab.
**IONOSPHERIC AND TROPOSPHERIC SCINTILLATION AS A FORM OF NOISE**
E. J. Fremouw and C. L. Rino *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 13 p refs (For availability see N76-16256 07-32)
(Contracts NAS5-21551; NAS5-21891; DASA01-68-C-0104; DNA001-74-C-0255; F30602-74-C-0279)

Recent tests of signals observed through the ionosphere, the solar wind, and a laboratory plasma have revealed a surprising consistency in parameters describing the first order statistics of a signal caused to scintillate by a randomly structured plasma. This paper describes a means for exploiting these new findings in a transionospheric communication channel model. Author

**N76-16263** SIGMA Association, Hamburg (West Germany).
**THE INFLUENCE OF PARTICULAR WEATHER CONDITIONS ON RADIO INTERFERENCE**
C. Fengler *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p refs (For availability see N76-16256 07-32)

The various propagation properties of the atmosphere are associated to the variation of the refractive index. A stratified atmosphere shows due to the meteorological parameters a strong change which corresponds for example to variations of parameters as k-factor or radio horizon and noise temperature. The case of an atmosphere with embedded discontinuities is illustrated by experimental results, which were obtained on line-of-sight ground links, links with a distance near the radio horizon, transhorizon links as well as earth-space links. It concludes that most radio interference is to be expected during days with strong radiation and the influence of cold fronts. Author

**N76-16264** SEFTIM, Paris (France).
**ELECTROSTATIC CHARGES AND THEIR PERTURBING**

**EFFECTS ON RADIO COMMUNICATION [LES CHARGES ELECTROSTATIQUES ET LES PERTURBATIONS QU'ELLES ENTRAINENT DANS LES LIAISONS RADIOELECTRIQUES]**
Charles Fevrot *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 4 p In FRENCH (For availability see N76-16256 07-32)

The following areas related to the effect of electrostatic charges on aircraft radio communication were discussed: (1) electrostatic charges and potential distribution on the surface of aircraft, (2) generation of these charges, (3) jamming effects, (4) suggested solutions. High electrostatic potential differences may exist between the metallic surface of aircraft and the surrounding air, or between two neighboring points of an insulating surface, although metallic surfaces may be assumed to be equipotential. Such charges may be generated by phenomena linked to the surrounding atmosphere, the aircraft itself, or other special situations (such as in-flight refuelling, braking on a dry runway, etc.). Radio jamming resulting from these charges takes the form of a general increase in background noise and, in certain cases, may be aggravated by noise resulting from sudden avalanche discharges. Suggested solutions include the development of improved paints with better conductivity properties.
Transl. by Y.J.A.

**N76-16265** Technische Hogeschool, Eindhoven (Netherlands).
**POLARIZED NOISE IN THE ATMOSPHERE DUE TO RAIN**
A. Mawira and J. Dijk *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 23 p refs (For availability see N76-16256 07-32)

Equations describing the propagation of plane waves through a medium containing axisymmetric rain drops are presented. They lead to a general expression for the cross polarization parameter. A transfer equation involving the stokes spectral parameters associated with the electromagnetic field in this medium, is also given. The solution of this equation shows that a polarization of the thermal emission in the atmosphere can be caused by rain. The evaluation of the cross polarization parameter from sky emission measurements is also discussed. Author

**N76-16266** Technische Hogeschool, Eindhoven (Netherlands).
**DEPOLARIZATION AND NOISE PROPERTIES OF WET ANTENNA RADOMES**
J. Dijk and A. C. A. VanDerVorst *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 16 p refs (For availability see N76-16256 07-32)

The influence of artificially wetted radome panels of different materials (Tedlar, Mylar, Teflon) on the performance of antenna systems covered with radomes was measured. Noise, transmission and depolarization measurements have been carried out and when possible compared with the theory. Author

**N76-16267** Institut fuer Physikalische Weltraumforshung, Freiburg (West Germany).
**ANTENNA RESPONSE TO RANDOM ELECTRIC FIELDS DUE TO THERMODYNAMIC DENSITY FLUCTUATIONS IN PLASMAS**
R. Grabowski *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 11 p refs (For availability see N76-16256 07-32)

Thermodynamic density fluctuations of positively and negatively charged components in a plasma are responsible for the occurrence of random electric fields. The antenna response to these fields may be characterized by the quadratic or power spectrum of the voltage fluctuations in a measuring device connected with the antenna. The response is dependent upon the antenna configuration and is described as a filtering effect in wave vector space. Theoretical quadratic spectra are presented for equilibrium plasmas streaming parallel to the antenna axis. The bulk velocity has a strong influence upon the shape of the spectra, especially as it is the cause for a periodic fine structure. Author

**N76-16268** Technische Hogeschool, Eindhoven (Netherlands).
**THE INFLUENCE OF FREQUENCY AND RECEIVER APERTURE ON THE SCINTILLATION NOISE POWER**
M. J. M. VanWeert *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p refs (For availability see N76-16256 07-32)

Some properties of the scintillation noise power are discussed. The used model is essential the same as used by Lee and Harp. Some calculations of different statistical properties of the scintillation noise are shown. Special attention is given to the influence of receiver aperture and frequency on scintillation noise power. It is shown that both parameters have a significant influence on amplitude scintillation, but hardly on phase scintillation. This behavior is explained. To decide whether scintillation does have a significant influence on the performance of a communication link, the total scintillation noise power is compared with thermal noise power on an earth to satellite path. Author

**N76-16269** Army Electronics Command, Fort Monmouth, N.J. Communications/ADP Lab.
**DOD ELECTROMAGNETIC COMPATIBILITY PROGRAM: AN OVERVIEW**
John J. ONeil *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 6 p refs (For availability see N76-16256 07-32)

An overview of the Department of Defense Electromagnetic Compatibility Program is presented. This integrated program intended to ensure the electromagnetic compatibility of all electrical and electronic equipments, subsystems and systems produced and operated by components of the Defense Department in any electromagnetic environment, resulted in the establishment of eight major program areas. The status of each of these areas is examined with particular emphasis on the areas of EMC standards and specifications and measurement techniques and instrumentation. Plans of the Department of Army to solve operational problems are also reviewed. Author

**N76-16270** Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
**GENERAL EMC SPECIFICATION OR SYSTEMS ORIENTED EMC SPECIFICATIONS**
D. Jaeger *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 12 p (For availability see N76-16256 07-32)

To ensure electromagnetic compatibility in systems, EMC equipment specifications are required to limit for each unit the interferences emitted and specify a certain degree of unsusceptibility to interference signals. An examination is made as to whether it is more favorable to use a general EMC specification or system oriented specifications for this purpose. The following solution is obtained: The test methods and the test philosophy should be uniform for all systems. MIL-STD 462 (+ 463) could represent a good basis. However, updating and expansion in various respects seem desirable. As far as the limit values are concerned, it becomes evident that the characteristics of the systems themselves, their environment, and the system in conjunction with which they must possibly function differ too greatly. Establishing system related limit values is considered the optimum solution. Author

**N76-16271** Societe Nationale Industrielle Aerospatiale, Blagnac (France).
**ELECTROMAGNETIC NOISE SPECIFICATIONS [SPECIFICATIONS EMC]**
J. C. Delpech *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 21 p In FRENCH (For availability see N76-16256 07-32)

Various EMC standards and specifications now in use were compared, with special emphasis on those applicable to airborne systems. The essential similarities and differences between these specifications were pointed out, in relation to the following: type of tests used, frequency bands applicable, degree of required tolerance demanded, operating regime specified, and recommended hardware. The following points were also emphasized: (1) the lack of adequate tests required by certain specifications (such as those used to evaluate the vulnerability of numerical equipment), (2) the new tests required in the most recent specifications, (3) the lack of precision and unsatisfactory matching between certain limits which have been observed experimentally, and (4) the superiority of certain specifications in relation to the measurement principles and instruments used. Transl. by Y.J.A.

**N76-16272** Stanford Research Inst., Arlington, Va.
**A STATUS REPORT OF THE IEEE/ECAC ELECTROMAG-**

**NETIC COMPATIBILITY FIGURE OF MERIT COMMITTEE**
G. H. Hagn and M. N. Lustgarten (IIT Res. Inst., Annapolis, Md.) *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 15 p refs (For availability see N76-16256 07-32)

A practical technical procedure is devised for specifying an electromagnetic compatibility Figure of Merit (FOM) for various electronic devices and systems. An EMC FOM for single channel voice communication systems, based on the channel denial concept, was developed by using a building block approach. The building block approach involves the use of relatively simple scoring formulas for selected EMC parameters, which are then linearly combined, with appropriate weighting factors, to calculate FOMs for transmitters, receivers, and systems. A channel was considered denied if $(S + I + N)/(I + N)$ smaller than or equal to 10 db in a moderately dense co-site environment. The parameter scoring equations were developed to reflect the frequency spectrum denied by each parameter. The weighting factors for the building block approach were determined by running a computer program that kept track of the number of channels denied by each parameter. Example calculations for HF, VHF, and UHF systems are given, and the interpretation of the scores is discussed. Author

**N76-16273** Ministry of Defence, London (England).
**ELECTROMAGNETIC COMPATIBILITY IN MILITARY AIRCRAFT**
D. H. Hight and W. A. Kelly *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 5 p ref (For availability see N76-16256 07-32)

Common sources of electromagnetic compatibility problems ar3 outlined and the difficulties confronting engineers who are responsible for producing successful aircraft weapon systems are discussed. A definition of EMC is given within the context of an aircraft weapon system. EMC problems can be minimized by: defining clearly the requirements of the weapon system; translating this requirement into an overall system specification; defining subsystem and installation specifications; writing an EMC control plan; and producing a detailed test plan. Author

**N76-16274** Lucas Aerospace Ltd., Hemel Hempstead (England).
**ELECTROMAGNETIC COMPATIBILITY CONTROL PLANS**
P. D. Campbell *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 21 p refs (For availability see N76-16256 07-32)

The spectrum and level of radio interference have been measured for years and unwanted emissions reduced retrospectively. This remedial approach is now recognized as inefficient but the concept of electromagnetic compatibility as a design parameter still requires emphasizing. The devices, circuits, components and constructional details which can contribute to the creation, conduction and emission of unwanted signals are indicated and means whereby their effects can be minimized are examined. The problems arising in creating and implementing a control plan for the development of a typical piece of electrical equipment are outlined and the difficulties experienced in balancing operational, theoretical, practical and contractual requirements are highlighted. Author

**N76-16275** Signals Research and Development Establishment, Christchurch (England).
**A CASE FOR AN EVALUATION AND ADVISORY SERVICE**
E. M. Frost *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 5 p (For availability see N76-16256 07-32)

The requirement to exchange, interwork and co-site equipments and systems, coupled with the widening use of semiconductor devices for new as well as traditional applications, has led to the concept of an overall Electromagnetic Compatibility (EMC) activity. However, there is no generally accepted definition for EMC as separate interests are tending to retain their own limited interpretations. It is believed that this is causing interface difficulties that will prevent EMC adapting itself sufficiently rapidly to deal with this changing and expanding electronic situation. After considering EMC as a typical pollution situation a suggestion is made for an evaluation and advisory service that would provide an interface between other EMC and allied activities and also act as a focus and creative development point for new ideas and techniques. Author

**N76-16276** Thomson-CSF, Levallois-Perret (France).
**INTERFERENCES IN FREQUENCY MODULATION SYSTEMS [INTERFERENCES DANS LES SYSTEMES A MODULATION DE FREQUENCE NO. 21]**
G. Crocombette *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 16 p In FRENCH; ENGLISH summary (For availability see N76-16256 07-32)

Interference problems applicable to telephone radio links with multiplexing repeated in frequency (FDM-FM) were discussed. A general treatment applicable to all FM links was first presented, including: (1) typical organization of links and equipments, (2) effects of disturbances on the operation of equipment (capture of AGC and limiters) and on overall performance (noise after demodulation), (4) procedures used to reduce the effects of disturbances, and (5) calculation of the level of disturbances from the radiation diagrams and application to two special cases. The rest of the report was limited to FDM-FM telephone radio links with moderate to large capacities. Measurement results of reciprocal perturbations between different radio links of normal capacity were presented. Finally, radiation pattern diagrams used in the design of a network system were illustrated.
Transl. by Y.J.A.

**N76-16277** Army Electronics Command, Fort Monmouth, N.J.
**RADAR INTERFERENCE REDUCTION TECHNIQUES**
William Fishbein, Reinhard Olesch, and Otto Rittenbach *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 23 p refs (For availability see N76-16256 07-32)

Techniques are described, applicable to radar, which enhance the compatibility of multiple systems in limited frequency space. By appropriate combination of multiple frequencies, the spectral occupancy of a signal can be reduced through pulse shaping, without sacrifice in range resolution. This method is extended to continuous wave radar, resulting in sidelobe reduction without amplitude modulation. A function is defined relating mutual interference of two systems in terms of their waveforms, physical and spectral proximity, and is used as a measure of interference. Ordinary single sideband techniques are modified and applied to radar to reduce spectral width. Considerations for interlacing the discrete line spectra of several radars are given. They include single sideband processing of unidirectional doppler signals and a step scanning scheme which permits increasing the allowable pulse rate. Author

**N76-16278** Electromagnetic Compatibility Analysis Center, Annapolis, Md.
**APPLICATION OF PROGRAMMABLE CALCULATORS TO EMC ANALYSIS**
J. P. Georgi (Dept. of Defense) and Paul D. Newhouse (ITT Research Inst.) *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 14 p refs (For availability see N76-16256 07-32)

The use of programmable calculators is suggested for making electromagnetic compatibility calculations conveniently and economically. Programmable calculators are available at prices ranging from about $800 to $5000. Programs recorded on magnetic cards or tapes for use with the popular U.S. makes of calculators will be available from the Department of Defense, Electromagnetic Compatibility Analysis Center (ECAC) in 1975. Detailed explanations of several of the ECAC programs are given to illustrate the kinds of calculations that can be performed and to indicate the ease with which the programs can be used. Guidelines for the selection of calculators, and the pros and cons of using them are given. Author

**N76-16279** Electromagnetic Compatibility Analysis Center, Annapolis, Md.
**APPLICATION OF MARKOV CHAIN THEORY TO THE MODELLING OF IFF/SSR SYSTEMS**
Stephen J. Sutton (IIT Research Inst.) and C. Wayne Ehler (IIT Research Inst.) *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 23 p refs (For availability see N76-16256 07-32)

The automated IFF/SSR prediction model was constructed around the Markov chain models. Inputs to the prediction model

include the interrogator environment and an air traffic deployment for a specific geographic area. For each transponder in the deployment the model determines those interrogators whose signals are received, calculate the transition probabilities, selects the proper Markov chain, and calculates transponder performance parameters. These parameters are then used to calculate the performance of a selected interrogator system. To gain confidence in the model predictions, results were compared with predictions from a previously validated simulation and with available measured interrogation and suppression arrival rates. The comparison showed that the IFF/SSR model predictions correlated well with both the other predicted data and the measured data. The results of this paper show that the IFF/SSR prediction model with Markov chain transponder models provides a powerful, flexible, reliable, and accurate analysis capability. Author

**N76-16280** British Aircraft Corp., Filton (England). Electronic Systems Group.

**COMPUTER GENERATION OF AMBIGUITY SURFACE FOR RADAR WAVEFORM SYNTHESIS**

R. J. Morrow and G. Wyman *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 11 p refs (For availability see N76-16256 07-32)

Recent advances in the field of surface acoustic devices are likely to encourage the implementation of complex forms of matched filter radars. As a consequence, the system designer and EMC Analyst will require convenient methods establishing the likely system performance obtained from the various forms of signal processing. One well established technique used to determine the theoretical performance of matched filter or correlation receivers is through the application of the ambiguity function. This function has wide application as it may be employed to evaluate the theoretical received signal response in both the time and Doppler domains. As this function handles both matched and unmatched signals it provides a convenient method of assessing both the design and eventual electromagnetic compatibility of the system. With these considerations in mind a general computer method of solving the ambiguity function has been developed and is described in this paper. Author

**N76-16281** Electronic Communications, Inc., St. Petersburg, Fla.

**ANTENNA-TO-ANTENNA EMC ANALYSIS OF COMPLEX AIRBORNE COMMUNICATION SYSTEMS**

William L. Dillion *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 16 p ref (For availability see N76-16256 07-32)

Methodology and applied techniques for antenna-to-antenna electromagnetic compatibility analysis of complex airborne communication systems are presented. Potential interference modes and system isolation factors are examined in conjunction with a typical equipment complement. A method of analysis is discussed which uses computer calibrated antenna space isolations with conventional analysis techniques. Some typical analysis results are presented in summary form. Antenna isclation is discussed as a limited factor for EMC optimization. The results of past analysis clearly show the need for frequency management to effect interference control as an integral part of the antenna-to-antenna EMC profile of complex airborne systems. Author

**N76-16282** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**ANALYSIS OF THE NOISE AND ITS INFLUENCE ON COMMUNICATION SYSTEMS [ANALYSE DU BRUIT ET DE SON INFLUENCE SUR LES SYSTEMES DE COMMUNICATION]**

Roger Gouillou *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 7 p refs In FRENCH; ENGLISH summary (For availability see N76-16256 07-32)

The paper aims at providing the communications engineer with guidelines in view to minimize the loss of information through signal reception and processing, by keeping to a minimum the introduction of noise at the different stages of data treatment. It summarizes, from this point of view, the many theoretical works found in the literature, and emphasizes the practical steps leading to the results. Noise and signal are considered through their respective spectral representations. This permits, through well known concepts, a definition of the effect of signal masking by the noise, and the calculation of the noise level as a function of processing means. Formulas established this way are easily applicable to various practical cases. Problems raised by the discovery of the signal within the noise are also mentioned. Author

**N76-16283** Rome Air Development Center, Griffiss AFB, N.Y.

**COMPUTER MODELING OF COMMUNICATIONS RECEIVERS FOR DISTORTION ANALYSIS**

J. F. Spina and D. D. Weiner (Syracuse Univ.) *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 14 p (For availability see N76-16256 07-32)

Details of an analysis technique and companion computer program are presented that have application in the area of design and analysis of electronic circuits. Particular emphasis is placed upon the application of the program to the modeling of nonlinear distortion effects in communication receivers. A discussion of moderately nonlinear systems and the treatment of such systems using the nonlinear transfer function approach is followed by circuit analysis as a potential tool in designing and evaluating circuits from an electromagnetic compatibility point of view. An overview of the computer program in terms of some of its more salient features is provided. Author

**N76-16284** Norges Tekniske Hoegskole, Trondheim.

**COMPARATIVE ANALYSIS OF MICROWAVE LANDING SYSTEMS WITH REGARD TO THEIR SENSITIVITY TO COHERENT INTERFERENCE**

Borje Forssell *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 8 p (For availability see N76-16256 07-32)

Proposed landing systems were computer simulated to examine their behavior in a realistic multipath environment. Models of airfields were elaborated and the reflected and direct signal components were used as inputs to mathematical models of the receiving systems to compute the resulting position errors. This study showed that it would be possible to use groups of synthetic interference components for the same purpose. By carefully choosing the distribution of the coherent interference, the significance of the comparison can be improved and the amount of work reduced. Author

**N76-16285** Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.

**THE CROSSED-DIPOLE STRUCTURE OF AIRCRAFT IN AN ELECTROMAGNETIC PULSE ENVIRONMENT**

Robert W. Burton *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 15 p refs (For availability see N76-16256 07-32)

The crossed dipole receiving antennas has been used as a representative model to approximate electromagnetic pulse effects on aircraft. Electromagnetic properties of the crossed dipole receiving antenna illuminated by a monochromatic source are considered. Results are presented for electrically moderately thin structures. In practice, when a crossed dipole receiving antenna is excited by a broad spectrum electromagnetic pulse, certain important electrical resonances occur; that is, at specific single frequencies of excitation some portions of the structure can support large amplitude standing waves of current and/or charge. Under such conditions a current maximum/charge minimum, current minimum/charge minimum, or current minimum/charge maximum may occur at the junction region. Examples of resonant and antiresonant situations for the parasitic monopole and the crossed dipole which highlight the possible interactions between the arms of the crossed dipole are presented which give insight into methods of analyzing aircraft in an electromagnetic pulse environment. Author

**N76-16286** Telecommunications Radioelectriques et Telephoniques, Le Plesis-Robinson (France).

**DESIGN PROBLEMS RELATED TO RADIO COMMUNICATION WITH AN INTEGRATED AIRBORNE SYSTEM [PROBLEMES POSES PAR LA TRANSMISSION DANS UN SYSTEME INTEGRE AEROPORTE]**

G. David et Vannetzel *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p refs (For availability see N76-16256 07-32)

An integrated communication system with second order

redundancy (as a back-up against breakdown) was investigated. Reasonable series and parallel circuits, assumed to be controlled by a management unit, and from which exchange principles may be shown, were illustrated. A number of communication problems between the transmission system and hardware components were briefly examined; such communication messages may be transmitted with a NRZ-type code. If distances are taken into account, a biphasic code is preferable since it eliminates any steady component from the main transmission line. Finally, numerical data transmissions facilitate the control of information and thereby decrease the possibility of errors. Transl. by Y.J.A.

**N76-16287** Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
**DIGITAL DATA TRANSMISSION IN AIRCRAFT EMC-PROBLEMS AND POSSIBLE SOLUTIONS**
R. Rode *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p (For availability see N76-16256 07-32)

In the use of digital systems in aircraft, where a great deal of interference emission and very sensitive equipment are concentrated in a small space, new problems can arise due to the special type of emission and susceptibility of the digital systems. Great care must therefore be laid on the selection of the cabling (twisting rate, shielding), the line drivers and receivers, the rise and fall time, and the transmission rate. To prove in practice the meaning of theoretical evaluations of a choice of line drivers, line receivers and cables, special tests were performed on EMC test facilites. These tests also covered the different shielding and earthing possibilities. Special EMC tests were established to prove the compatibility of the digital systems with the complete aircraft system. Author

**N76-16288** Electronique Marcel Dassault, St. Cloud (France).
**GENERATION AND EFFECTS OF CONDUCTION AND RADIATION NOISE VOLTAGES BETWEEN THE COMPONENTS OF A SINGLE SYSTEM [GENERATIONS ET EFFETS DES TENSIONS PARASITES DE CONDUCTION ET DE RAYONNEMENT ENTRE ENSEMBLES D'UN MEME SYSTEME]**
A. Quidet *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 14 p In FRENCH (For availability see N76-16256 07-32)

The main interference effects between the various components of electronic airborne systems were discussed, with emphasis on protection techniques and policies that should be adopted. In recent years, the introduction of digital numerical techniques, despite their numerous advantages, have complicated the integration of components using these techniques. Protection policies against such interferences rest on the following objectives: (1) limitation, insofar as possible, in the number of static noise generators, (2) reduction of the undesirable coupling effects, (3) avoiding perturbing effects by selecting appropriate techniques for data transmission. In addition, airborne system components are regulated by certain standards and specifications such as: AIR 510 C fourth edition of 15 Feb. 1963, Mil Std 461 A of 1 Aug. 1968, Mil Std 462 of 31 July 1967. Transl. by Y.J.A.

**N76-16289** Siemens A.G., Munich (West Germany).
**THE REDUCTION OF ELECTROMAGNETIC COMPATIBILITY DUE TO NON-LINEAR ELEMENTS AND UNINTENDED RANDOM CONTACTING IN THE PROXIMITY OF THE ANTENNA OF HIGH-POWER RF-TRANSMITTERS**
K. Landt *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p refs (For availability see N76-16256 07-32)

With the aid of selective filters it is possible to almost completely eliminate harmonics, spurious emissions and wideband interfering signals on the output of RF transmitters, even those operating at very high output powers. These interfering signals are again generated, if nonlinear junctions or unintended random contacting create secondary radiation sources in the proximity of the transmitting antennas. The problems indicated are discussed with reference to an example for the installation of a UHF-unit and an avionic device in an aircraft, as well as on the example of an installation onboard a ship. Author

**N76-16290** Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
**IMPROVED DESIGN OF INTERFERENCE SUPPRESSORS AND MEASUREMENT OF ATTENUATION CHARACTERISTICS**
M. L. Jarvis and J. D. Hawkett *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 13 p (For availability see N76-16256 07-32)

The mathematic approach and results are reported in the development of a new design of interference suppressor which eliminates the resonances normally occurring between a suppressor and its load. Also described are shortcomings of conventional 50 ohm insertion loss measurements, and a characteristic based on critical load conditions is proposed. Author

**N76-16291** Army Missile Command, Redstone Arsenal, Ala.
**MISSILE INTERSYSTEM EMC TESTING**
Charles D. Ponds *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p refs (For availability see N76-16256 07-32)

The intersystem EMC testing of missiles is described. Systems compatibility to a world wide electromagnetic environment is demonstrated by using mini computer control, broadband emitters, a unique data acquisition system, an infrared data link and a minicomputer data reduction system. Also, redesign information is acquired which will provide EM hardened missiles. The simulation facility used to provide an EM environment from 100 KHz to 15 GHz is described giving the emitter power output, modulations, sweep capabilities, log periodic and horn antenna, transmission line transverse electromagnetic mode test chamber and a minicomputer for close loop control of emitters, power and frequency controller, data acquisition and reduction. Author

**N76-16292** Aeritalia, Turin (Italy).
**MEASUREMENT OF INTERWIRING COUPLED NOISE**
B. Audone and L. Bolla *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 13 p refs (For availability see N76-16256 07-32)

One of the major problems arising in the electromagnetic compatibility analysis of a complex system such as an airplane is the wiring interconnecting the equipments. A large amount of interference is picked-up among cables in the same loom when, due to limited available space, emitting and sensitive wires are not sufficiently separated. A test method to measure the coupling interference and susceptibility in different load configurations (open or short circuit) is proposed with the advantage of having a realistic simulation of the wiring coupling mechanism and valid guidelines for a better cable separation philosophy. Author

**N76-16293** Genoa Univ. (Italy).
**ON THE EVALUATION OF MAN-MADE ELECTROMAGNETIC NOISE INTERFERING WITH COMMUNICATIONS IN THE E. L. F. RANGE**
Giorgio Tacconi *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 18 p refs (For availability see N76-16256 07-32)

The mechanics of some aspects of the man made electromagnetic noise at the E.L.F. are examined that are the most favorable for propagation in dissipative media. In particular, the noise is considered as generated by a moving ship in the vicinity of an electromagnetic sensor immersed in the sea. Mathematical and experimental approaches for an estimation of such noise are proposed. Some experimental results obtained in the Tyrrhenian sea are shown in accordance with theories and experiments. Local natural background noise as well as nearly and far off man made noise are considered in the context of a general transmission channel. Author

**N76-16294** Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
**AUTOMATIC TESTING OF AVIONICS SYSTEMS FOR ELECTROMAGNETIC COMPATIBILITY**
Edmund T. Tognola *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 10 p refs (For availability see N76-16256 07-32)

A technique of semi-automatic electromagnetic compatibility testing is described that involves the use of a data acquisition

unit integrated into the aircraft avionics and electrical subsystems. This enables the test engineer to gather EMC performance data on the system in its natural environment. The onboard recorded data is subsequently reduced by computer using specially developed programs to determine areas of non-compatibility. The results of the investigation indicate that the technique of using a data acquisition system for EMC testing is feasible and requires less test effort and provides more complete and accurate results than conventional EMC testing. Author

**N76-16295** American Electronic Labs., Inc., Lansdale, Pa. Communications Lab.

**DESIGN OF A COMMUNICATIONS TEST (TEMPEST) RECEIVER FOR MAXIMUM BROADBAND DYNAMIC RANGE**

J. B. Hager, J. C. Jones, and J. R. VanCleave *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 6 p (For availability see N76-16256 07-32)

In any receiving system, but especially in communications test receiving systems, dynamic range is a key parameter. A particularly difficult receiving frequency range is 1 kHz to 1 MHz, where unshielded ambient noise intensity is very high, and adequate shielding is impractical. In a high noise ambient, the receiving system sensitivity becomes equal to the ambient level minus the receiving system dynamic range, which is invariably higher than KTB (thermal) noise. The design of a receiver for maximum performance in detection of broadband signals is significantly more stringent than that of narrow band signals, and requires the techniques described in this paper. Importance is placed on successive filtering of the receiver channel and maximizing signal handling capability. The related considerations concerning local oscillator rejection for maximization of tuning range and equipment shielding are also presented. Author

**N76-16296** Ministry of Defence, Tel-Aviv (Israel). Armament Development Authority.

**A STRAIGHT FORWARD COMPUTER ROUTINE FOR SYSTEM CABLE EMI ANALYSIS**

M. Russo and O. Hartal *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 11 p refs (For availability see N76-16256 07-32)

A method is reported that provides harness compatibility in a complex system, the design of which is limited. The method outlined provides a way whereby engineering effort and a computational backup check are combined to generate the EMC requirements in as short a time as possible. The data reduction phase is simple, time and effort saving and may be performed, after the primary effort phase, by non-EMC-skilled workers. The method as such is system oriented and meets the requirements of a specific design problem. Author

**N76-16297** American Electronic Labs., Inc., Lansdale, Pa.

**A UNIVERSAL ELECTROMAGNETIC COMPATIBILITY (EMC) ANALYZER UTILIZING BASIC CIRCUIT MODULES**

Karl E. Wieler and Warren A. Kesselman (Army Electron. Command, Fort Monmouth, N. J.) *In* AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 16 p (For availability see N76-16256 07-32)
(Contract DAAB07-71-C-0339)

A measurement instrument was developed to give EMI-RFI testers more reliable information on received signals of an unknown nature. The amplitude distribution measurement can be applied to any situation where the distribution of a signal is desired. An evaluation of various detector modules defined usable measurement techniques for various signal types. New measurement concepts are introduced to the EMI/RFI field to give increased data on a detected unknown signal and certainly more reliable data than that taken with present measurement techniques and systems. Author

**N76-16298#** Lockheed Missiles and Space Co., Palo Alto, Calif.

**MEASUREMENT OF THE GRAVITATIONAL FREQUENCY SHIFT IN THE RADIO BAND BY USING AN ARTIFICIAL EARTH SATELLITE**

B. M. Chikhachev, N. E. Ivanov, G. M. Fedorenko, A. A. Korchak, I. I. Stakhanov, V. V. Belyi, I. G. Boldovskaia, and E. A. Kornitskaia 1975 9 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. 13, no. 3, 1975 p 381-388
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

Results of measurements of the gravitational frequency shift obtained by using a molecular generator on an artificial earth satellite are presented. The Cosmos-145 satellite was injected into an elliptical orbit on 3 March 1967 (220 km perigee, 2135 km apogee). All the ground-based and onboard apparatus (with the three ground-based molecular generators included) were first checked out by using the Cosmos-97, satellite. The relative frequency stability during that session delta turned out to be approximately 10 to the -11 power. The frequency shift observed in the Cosmos -145 experiment (after excluding the ionosphere) agreed in magnitude (with a 30% error) and sign with theory. Author

**N76-16299#** Lockheed Missiles and Space Co., Palo Alto, Calif.

**FUNDAMENTAL CONCEPTS AND RELATIONSHIPS OF THE THEORY OF POLARIZATION MODULATION (PM) SIGNAL RECEPTION, CHAPTER 7**

K. G. Gusev, A. D. Filatov, and A. P. Sopolev [1975] 29 p Transl. into ENGLISH from the book "Poliarizatsionnaia moduliatsiia" Moscow, Sovetskoe Radio, 1974 p 164-200
Avail: NTIS HC $4.00; National Translations Center, John Crerar Library, Chicago, Illinois 60616

Problems of the theory of optimal reception of polarization modulated oscillations are discussed; these include seeking means of realizing systems operating with PM signals according to optimum decision rules, determining the minimum PM signals which can still be received with an admissible error risk, and estimating the actual PM signal receiving systems by comparing them with optimal systems. Other topics discussed include statistical model of a communications system with PM signals, detection problem for PM signals, and the effect of additive interference on a PM signal. M.J.S.

**N76-16300#** Lockheed Missiles and Space Co., Palo Alto, Calif.

**OPTIMAL RADAR SIGNAL PROCESSING, CHAPTER 4**

M. I. Finkelshtein [1975] 61 p refs Transl. into ENGLISH from the book "'Osnovy radiolokatsii' Moscow, Sovetskoe Radio, 1973 p 184-262
Avail: NTIS HC $4.50; National Translations Center, John Crerar Library, Chicago, Illinois 61606

In order to solve the radar signal detection problem, it is necessary to have 'a priori' information about the structure of the useful signal and interference. This information permits finding signal processing methods which are optimal from the viewpoint of some criteria; this affords the possibility of synthesizing the structure of optimal signal processing units. Quasi-optimal units were investigated. M.J.S.

**N76-16301*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**RADIATIVE TRANSFER IN A PLANE STRATIFIED DIELECTRIC**

Thomas T. Wilheit, Jr. Mar. 1975 23 p refs
(NASA-TM-X-71051; X-911-75-66) Avail: NTIS HC $3.50 CSCL 09C

A model is developed for calculating radiative transfer in a stratified dielectric. This model is used to show that the reflectivity of a stratified dielectric is primarily determined by gradients in the real part of the refractive index over distances on the order of 1/10 wavelength in the medium. The effective temperature of the medium is determined by the thermodynamic temperature profile over distances of the order delta T. Author

**N76-16302*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**PSEUDO NOISE CODE AND DATA TRANSMISSION METHOD AND APPARATUS Patent Application**

Leonard F. Deerkoski, inventor (to NASA) Filed 30 Dec. 1975 30 p
(NASA-Case-GSC-12017-1; US-Patent-Appl-SN-645510) Avail: NTIS HC $4.00 CSCL 17B

A data transmission system is described in which pseudo noise ranging codes and a pair of binary data sources digitally modulate a suppressed carrier wave having a first frequency. Two additional binary data sources, digitally modulate a suppressed carrier wave having a second frequency. The first and

second frequencies are only slightly displaced so that the frequency bands which modulate the two carriers overlap. The two suppressed carrier waves are linearly combined and transmitted so that the amplitude of the first wave does not degrade the detectability of the second. The information modulated on the second carrier is coherently detected to recover both signals. The signals modulated on the first carrier are recovered by a pair of matched filters. The two derived pseudo noise codes are mixed with the received signal to increase the amplitudes of the two data sources modulating the first wave above the amplitude of the second wave. NASA

**N76-16303#** Carleton Univ., Ottawa (Ontario).
**THE WIRED CITY LABORATORY AND EDUCATIONAL COMMUNICATION PROJECT: 1974 - 1975 Annual Report**
D. A. George May 1975 248 p refs
(AR-4) Avail: NTIS HC $8.00

The status of the physical facilities of the Wired City Laboratory is described, and programs of engineering development and of experimentation are reviewed. Other topics discussed include research and development in communications, the educational communications project, the CMR-RMC teleteaching project, the Carleton-Stanford curriculum sharing project, and the measurement of video image activity. M.J.S.

**N76-16304#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**DISCRETE ADDRESS BEACON SYSTEM (DABS) TEST PLAN FOR FY 1976**
W. H. Harman, V. A. Orlando, and D. Reiner 14 Nov. 1975 37 p refs
(Contracts DOT-FA72WAI-261; F19628-76-C-0002; Proj. 034-241-012)
(AD-A018011/7; ATC-56; FAA-RD-75-145) Avail: NTIS HC $4.00 CSCL 17/9

The test activities that have been planned to take place during FY 1976 in support of the Discrete Address Beacon System (DABS) were described. The special test facilities and techniques needed to collect and analyze the required data were also described. Author

**N76-16305#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**CYLINDRICAL GROUND-CLUTTER SHIELD**
Clovis Solano Pereira Feb. 1975 27 p refs
(INPE-639-RI/299) Avail: NTIS HC $4.00

A theoretical investigation of the influence of metal shields on antenna radiation patterns is performed. The study allows the determination of the optimal dimensions of a circular cylindrical, finite, perfectly conducting shield placed on the ground around infinitesimal sources located at its axis, in such a way that a minimum ground-side lobe is obtained. Two different methods are applied: the integral equation method and the geometrical theory of diffraction (GTD). When the dimensions of the cylindrical shield become very large compared to the wavelength, the first method involves a very large matrix which is impractical for the present computers to handle. Under these circumstances, GTD may be shown to be a very useful approach. For the range of dimensions where both methods are applicable, a comparison between them is made. Author

**N76-16306#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**OPTIMAL RECEPTION OF SIGNALS HAVING COMBINED BINARY AND CONTINUOUS PHASE MODULATION**
Rajat Kumar Saha [1975] 28 p refs
(INPE-640-RI/300) Avail: NTIS HC $4.00

A method of synthesis for optimum receiver for signals having combined pseudorandom noise (PN) sequence modulation and continuous phase modulation (PM) is proposed. The PN sequence, unknown at the receiving end, is assumed to be represented by a discrete (binary) Markov process while the phase of the modulated signal is modeled as a continuous Markov process. Optimum receiver structure and corresponding general measures of system performance are derived under the Bayes criterion of minimum average risk by reducing the problem to that of estimation under the uncertainty as to the binary levels of the PN sequence. It is shown that implementation of such a receiver involves probabilistic weighting scheme with evergrowing memory at the expense of any threshold detector which is used in conventional receivers. Author

**N76-16307#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**ARTIFICIALLY INDUCED ENHANCEMENTS IN THE IONOSPHERIC BACKSCATTER SPECTRUM NEAR ELECTRON GYROFREQUENCY AND SECOND HARMONIC PLASMA LINE**
W. E. Gordon and Luiz Alberto Vieira Dias Jan. 1975 15 p refs
(INPE-579-RI/268) Avail: NTIS HC $3.50

Examples of enhanced plasma line observations are described. The lines were enhanced by ionospheric heating with an HF transmitter and were observed by the radar backscatter principle. Author

**N76-16308#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**NONLINEAR GENERATION OF OSCILLATIONS IN THE ARECIBO HEATING EXPERIMENT**
L. A. VieiraDias Aug. 1975 15 p refs
(INPE-710-RRE/020) Avail: NTIS HC $3.50

Observations at Arecibo, Puerto Rico show enhancements on lines other than the plasma and ion lines. The results on the backscattered spectrum near twice the plasma line frequency present enhancements. No theory is suggested, however, the phenomenon is belived to be due to nonlinear effects taking place in the heated ionospheric plasma. Author

**N76-16309#** Saab-Scania, Linkoping (Sweden).
**SOME CHARACTERISTICS OF AN AMPLITUDE OR PHASE MEASURING CW-RADAR ALTIMETER OPERATING ABOVE A ROUGH SCATTERING GROUND SURFACE**
Sune Axelsson Dec. 1974 132 p refs
(SAAB-TN-70) Avail: NTIS HC $6.00

The properties of the altitude signal were analyzed for two radar altimeters of FMCW-type operating above a rough scattering surface. The influence of internal and external noise signals, which can be added to the reflected signal from the ground surface, were also considered. The results show that the noise level of the altitude output is mainly determined by the range spread of the different reflectors on the ground if interfering signals are negligible. However, a considerable reduction of the noise level is obtained if the bandwidth of the output is much smaller than the bandwidth of the Doppler spectrum. Also the design of the signal processing has a significant effect. A comparison with the lower bound of Cramer-Rao Inequality shows that the noise level of both an amplitude and phase measuring alimeter approaches this lower bound at hard filtering and optimum design. The relationships between the altitude noise, the profiling error, the smoothing effect on the sensitivity lobe, and the spectral characteristics of the surface roughness were also investigated in detail. Results indicate that sensitive roughness measurements from a satellite are feasible, for instance sea-state monitoring. Author (ESA)

**N76-16310#** Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
**ANALYSIS AND SIMULATION OF A SYNDROME DECODER FOR A CONSTRAINT LENGTH k EQUALS 5, RATE R EQUALS 1/2 BINARY CONVOLUTIONAL CODE**
J. P. M. Schalkwijk, A. J. Vinck, and L. J. A. E. Rust Apr. 1975 43 p refs
(TH-75-E-58; ISBN-90-6144-058-0) Avail: NTIS HC $4.00

An analysis and a computerized simulation were carried out for a syndrome decoder in order to determine the minimum amount of hardware required. The principle of syndrome decoding for $R = 1/2$ convolutional codes is explained, and the differences between Viterbi and syndrome decoding are described with regard to path registers and metric calculations. The selection of a particular $k = 5$ code is justified. Three codes are compared by computerized simulation, and a code is selected because the number of associated path registers is only nine and the metric table contains 1817 entries. This code has a good error correcting capability, and the amount of hardware of the syndrome decoder

is significantly smaller than that of the classical Viterbi decoder. Author (ESA)

**N76-16311#** National Physical Lab., Teddington (England). Div. of Computer Science.
**SIMULATION STUDIES OF THE EFFECT OF LINK BREAK-DOWN ON DATA COMMUNICATION NETWORK PERFORMANCE**
W. L. Price and G. W. Cowin Feb. 1975 23 p refs
(NPL-Com-77) Avail: NTIS HC $3.50

Effects of link failures have been investigated for packet switching data networks by simulation. A protocol is described which enables the network to recover after a failure with no loss of data packets. The performance of the depleted network has been studied at various loads and the effect of isarithmic control on the behavior of a network that includes a bottleneck has been investigated. A brief account is given of a program of work on the enhancement of the network by the addition of extra links. Author (ESA)

**N76-16312#** National Physical Lab., Teddington (England). Div. of Computer Science.
**LINK PROTOCOLS FOR USE IN PACKET-SWITCHING NETWORKS**
P. T. Wilkinson Feb. 1975 31 p refs
(NPL-Com-78) Avail: NTIS HC $4.00

A protocol is described which may be used to achieve controlled and reliable transmission of blocks of information along an error-prone transmission link, and two more complex protocols are proposed which can operate more efficiently under these circumstances. The emphasis is towards the specification of a realistic network model the performance of which may then be estimated using simulation. ESA

**N76-16313#** Stanford Research Inst., Menlo Park, Calif.
**THE ACQUISITION AND USE OF SPECTRUM MONITORING DATA Final Report, Jan. - Oct. 1974**
T. I. Dayharsh, D. M. Jennings, and R. C. Kunzelman Feb. 1975 117 p refs
(Contract FCC-0039)
(PB-244617/7; FCC/OCE/SMTF-75/02) Avail: NTIS HC $5.50 CSCL 17B

Some of the time and space variations in the occupancy of the land mobile channels and the characteristics of the users of the channels were studied. The analysis of monitoring data for quantifying these variables is described along with additional monitoring experiments and analyses required for further quantification. By quantification of occupancy variations, the Regional Task Force will be able to optimize the monitoring program for the region. The current status of the user characterizations are explored and areas for further exploration are recommendedended. Both measured channel occupancy data and user characteristics will be used in the development of improved algorithms for assigning these users to the available channels. At the time of this report, the Chicago Regional Office is in an operational mode and is assigning and licensing applicants to land mobile channels. The regional system, while vastly superior to the assignment system it replaces, is still in a state of evolution. Some of the aspects of that continuing evolution are discussed. GRA

**N76-16314#** Office of Telecommunications, Boulder, Colo. Inst. for Telecommunication Sciences.
**MF CHANNEL-SIMULATOR MEASUREMENTS AND PERFORMANCE ANALYSES ON THE USC-10, ACQ-6, AND MX-190 PSK MODEMS Final Report**
Clark C. Watterson and Carl M. Minister Jul. 1975 280 p refs
(COM-75-11206/0; OTR-75-56) Avail: NTIS HC $9.25 CSCL 17B

The ITS Ionospheric Channel Simulator used to obtain HF error-probability performance measurements on three frequency multiplexed, time-differential, phase shift keyed (PSK) modems is described along with the three PSK modems. Explanations are given of how the channel and receiving system distortions affect the modems' performances, in terms of both the channel time varying frequency response and the detector response (signal ambiguity function). The experimental equipment is described, including the specially developed test set for generating random transmitted data and detecting bit and block errors, and the online minicomputer which delivered running values of the accuracies of the error-probability measurements. GRA

**N76-16315#** Office of Telecommunications, Boulder, Colo. Inst. for Telecommunication Sciences.
**AN ANALYSIS OF DEEP FADING IN THE 10 TO 40 GHz BAND ON A LINE-OF-SIGHT PATH**
M. C. Thompson and H. B. Janes Jul. 1975 38 p
(Contract F33615-72-M-5014)
(COM-75-11195/5; OTR-75-69) Avail: NTIS HC $4.00 CSCL 20N

Amplitude measurements of signals at 9.5, 19.1, 22.2, 25.4, and 33.3 GHz were made simultaneously using a 64 km path extending from 20 m to 3000 m elevation. Data from periods of deep fading were analyzed with respect to the improvement that would have been obtained by the use of frequency diversity. For the seven periods analyzed, the improvement from adding a second frequency varied from 6 to 17 db. No strong dependence of improvement on frequency separation is apparent. GRA

**N76-16316#** New Mexico State Univ., University Park. Engineering Experiment Station.
**ERROR IN ENERGY SPECTRUM DUE TO QUANTIZATION, PART 1 Final Report, 14 Jan. 1974 - 13 Jan. 1975**
Lonnie C. Ludeman 1 Feb. 1975 13 p refs
(Grant DAHC04-74-G-0084)
(AD-A014948; ARO-11422.2-A-Pt-1) Avail: NTIS CSCL 17/2

The report investigates the error in the Discrete Fourier Transform (DFT) caused by the quantization of the input values by an analog to digital converter and ignoring the round-off errors caused by the DFT algorithm. The expected value of the error was shown to be the product of the number of samples taken and quantization variance while the variance of the error was shown to be not only a function of the number of samples and quantization variances, but also a function of the fourth moment of the quantization error and the true value of the output. Author (GRA)

**N76-16317#** Corning Glass Works, N.Y.
**RESEARCH AND DEVELOPMENT ON ULTRA-LIGHT-WEIGHT LOW-LOSS OPTICAL FIBER COMMUNICATION CABLE Final Report, 1 Jul. 1973 - 1 May 1975**
J. F. Frazier and R. A. Miller Jul. 1975 86 p refs
(Contract DAAB07-73-C-0348; DA Proj. 1S7-62705-AH-94)
(AD-A015017; ECOM-73-0348-F) Avail: NTIS CSCL 17/2

An ultra-lightweight, low-loss optical waveguide communication cable was developed for tactical field army applications. The cable which resulted from this work was an all-dielectric structure, 5 mm (millimeters) in diameter, with an average waveguide attenuation of 7 db/km (kilometer) at 820 nm (nanometers). It weighed 22 kg/km (kilograms/kilometer) and the waveguides were easily accessible for termination purposes. Evaluation of this cable in terms of its optical, tensile, impact, twist, bend, vibration, moisture resistant and temperature properties shows that, with the exception of impact strength, it meets all the quideline requirements. GRA

**N76-16318#** Naval Postgraduate School, Monterey, Calif.
**IMPROVED SWEEP WAVEFORM GENERATOR FOR BISTATIC RADAR Technical Report, Jul. 1974 - Jun. 1975**
David B. Hoisington and Charles E. Carroll Aug. 1975 11 p
(AD-A014627; NPS-52Hs75081) Avail: NTIS CSCL 17/9

Although bistatic radar gives poorer range performance and poorer resolution than monostatic radar, bistatic radars have important uses. Improved circuits are described for generating the nonlinear waveforms required to give undistorted display in a bistatic radar. Author (GRA)

**N76-16319#** Ohio State Univ., Columbus. ElectroScience Lab.
**COMPLEX NATURAL RESONANCES OF RADAR TARGETS VIA PRONY'S METHOD Scientific Report**
C. W. Chuang and D. L. Moffatt Apr. 1975 35 p refs
(Contract F19628-72-C-0203; AF Proj. 5635)
(AD-A015062; ESL-3424-3; AFCRL-TR-75-0203; SR-3) Avail:

NTIS CSCL 17/9

It has been shown that extraction of complex natural resonances and residues from exact transient responses via Prony's method is both efficient and accurate. However, in the art of radar interrogation the exact transient response is difficult to obtain and the authors must be content with an approximate one. Knowing the complex natural resonances of objects is essential to one type of radar target discrimination. In this paper the authors consider the use of Prony's method in extracting complex natural resonances from approximate backscattered ramp responses of radar targets. A ramp waveform is used in radar target discrimination because a good approximation to the time domain response can be obtained with only a few harmonically related frequency domain responses via Fourier synthesis. By applying Prony's method to this approximate ramp response, a few dominant resonances which are close to the origin of the complex frequency plane can be extracted. This is quite encouraging because, for the purpose of radar target discrimination, only a few dominant modes are needed. Objects considered are prolate spheroids, simple wire aircraft models and some realistic aircraft models. The accuracy of this method is found to be good when compared to the results obtained by other techniques. GRA

**N76-16320#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.

**BACKSCATTERED SPECTRA FROM ROTATING AND VIBRATING SHORT WIRES AND THEIR RELATION TO THE IDENTIFICATION PROBLEM Physical Sciences Research Papers**

Ronald G. Newburgh and Giorgio V. Borgiotti 22 May 1975 39 p refs

(AF Proj. 5635)

(AD-A014779; AFCRL-TR-75-0298; AFCRL-PSRP-663) Avail: NTIS CSCL 17/9

In the report Rayleigh scattering for a short wire is examined for two simple motions, rotation and vibration. Rotation of the wire causes an amplitude modulation and vibration causes a phase modulation. Each of these modulations influences the backscattered spectra so that the characteristic frequency of the periodic motion appears. For the rotating wire, it is twice the rotation frequency. From the spectra it is possible to recognize the type of motion responsible. The study therefore serves as a first step in the development of models for complicated motions of actual objects such as tanks and trucks, thereby leading to possible vehicle signature classification schemes. The appendices include: a brief discussion of the formalism of polarization scattering matrices; a short examination of the relation between the scattered spectra due to periodic motions and the conventional Doppler effect; and an examination of the analogy between the rotating and vibrating wires and molecules as conventional Raman scatters, including a brief section on the energetics of the scattering process. GRA

**N76-16321#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.

**PROCESSING FOR MAXIMUM SIGNAL-TO-CLUTTER IN AMTI RADARS Physical Sciences Research Papers**

William B. Goggins, Jr. and John K. Schindler 19 Nov. 1974 46 p refs

(AF Proj. 5635)

(AD-A014783; AFCRL-TR-74-0577; AFCRL-PSRP-612) Avail: NTIS CSCL 17/9

Phased array antennas and Doppler signal processors designed to complement each other have been successfully used to maximize the signal-to-clutter (S/C) performance of AMTI radars. The optimum receiving antennas described in this paper allow for nonuniformities created in the ground-clutter Doppler spectrum by the transmitting antenna and processing of the received Doppler signal; the optimum signal-to-clutter digital processors allow for clutter spectra shaped by the combined effects of the transmitting-receiving antennas. The emphasis has been placed on producing antenna-processor designs that have complementary pass and reject bands. The mathematical techniques used in these designs maximize the ratio between the target signal and the clutter-plus-noise, expressed as a ratio of quadratic forms. The solution for the optimum design, which depends principally on the inversion of a single matrix rather than on any recursive technique, is obtained in closed form. GRA

**N76-16322#** Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

**INSTRUMENTATION TECHNIQUES FOR TRACKING LOW-FLYING VEHICLES Final Report, 1 Sep. 1974 - 10 Jul. 1975**

S. L. Robinette, J. E. Rhodes, Jr., R. D. Wetherington, E. K. Reedy, and R. D. Hayes 15 Jul. 1975 136 p refs

(Contract DAAD07-75-C-0025)

(AD-A015028; GIT-A-1678-F) Avail: NTIS CSCL 17/9

An analysis and evaluation has been made of available range instrumentation which would permit White Sands Missile Range to measure performance of low-flying missiles and aircraft, with the following accuracy objectives: (1) 10 feet in position, any axis; (2) 5 feet per second, in velocity; and (3) 5 feet per second in acceleration. A configuration was analyzed which used range measurements from ground sites to determine the position of an overflying aircraft, and tracking (measurements of range and pointing angles from the aircraft to the test vehicle) to determine the position of the low-flying vehicle. An inertial measurement unit, an altimeter, and a digital processor in the aircraft would establish attitude of the airborne reference system. No available airborne tracking equipment was found which would meet the White Sands Missile Range requirements. Both millimeter and laser airborne radars were evaluated as candidates for device development programs, to perform the function of airborne tracking. The possibility was examined of using an available Ku band airborne radar to determine altitude with 10 foot accuracy, the assumption being that higher horizontal position errors (approx. 50 feet) could be tolerated. A ground based laser radar network, and a multilateration technique were analyzed. The latter would require range measurements from ground sites to the low-flying target, from the ground sites to an overflying aircraft, and from the aircraft to the low-flying target. Author (GRA)

**N76-16323#** Epsco Labs., Stamford, Conn.

**DEVELOPMENT OF A SPEECH AMPLIFIER SYSTEM FOR USE WITH THE NAVY A4 OXYGEN BREATHING APPARATUS AND A PROPOSED FIREFIGHTING INSTRUCTOR'S BREATHING DEVICE Final Report**

Thomas A. Giordano Jul. 1975 88 p

(Contract N00024-75-C-4112)

(AD-A014653; Rept-5081-1) Avail: NTIS CSCL 17/2

The purpose of the program was to design, develop and fabricate a mask communication system for use with the A4 Oxygen Breathing Apparatus (OBA) and a modified Bio-Pak 45 Breathing Apparatus. The latter device has been proposed as a Navy Firefighting instructor's breathing apparatus. Firefighters and other Navy Damage Control personnel, who are required to wear breathing devices, are severely limited in their work effectiveness due to inadequate communications. The masks they are required to wear degrade the speech to such an extent that it is unintelligible, especially in the high ambient noise environments inherent with their work. In these high noise levels, the voicemitters in the masks are completely ineffective. A communication system was developed that gives a speech projection capability to the wearer, permitting a high degree of aural intelligibility over extended distances, in high ambient noise environments. GRA

**N76-16324#** McDonnell-Douglas Astronautics Co., St. Louis, Mo.

**DEVELOPMENT OF TECHNOLOGY FOR ASSESSMENT OF ELECTROMAGNETIC COUPLING. AUTOMATION AND EXTENSION OF MIL-STD-1377**

28 Feb. 1975 75 p

(Contract N00178-74-C-0524)

(AD-A014619; MDC-E1225) Avail: NTIS CSCL 09/1

Electromagnetic energy can be coupled from radiation fields to electronic system wiring and, depending upon the connections of the wiring, electromagnetic interference (EMI) can result in the system. The thrust of the contract is to develop a better understanding of the coupling mechanisms, and to improve the technology for assessing electromagnetic coupling in the one to ten gigahertz frequency range. The report deals with improvements in the techniques for measuring shielding effectiveness. GRA

**N76-16325#** Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
**RADIATION AND SCATTERING FROM LARGE POLYGONAL CYLINDERS, TRANSVERSE ELECTRIC FIELDS**
Joseph R. Mautz and Roger F. Harrington Jun. 1975 81 p refs
(Contract F19628-73-C-0047; AF Proj. 5635)
(AD-A014846; AFCRL-TR-75-0343) Avail: NTIS CSCL 20/14

The report deals with the computation of radiation and scattering of electromagnetic fields by electrically large convex conducting cylinders. A general computer program is developed for the case of transverse electric fields using the geometrical theory of diffraction. For a check of the computational accuracy, a computer program for a moment solution to the H-field integral equation is also developed. Illustrative computations are made for examples of radiation from a line source of magnetic current in the vicinity of a polygonal cylinder, scattering of plane waves, radiation from slots, and radiation from electric dipoles. Also given are examples of computations for conducting strips, grazing incidence on polygonal cylinders, and scattering from small cylinders. Complete program listings are included, with program descriptions, instructions for using, and sample input-output data. GRA

**N76-16326#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**POWERFLUX 1: A METHOD OF ESTIMATING WAVE INTENSITIES AT LARGE DISTANCES FROM GROUND-BASED LOW FREQUENCY TRANSMITTERS Environmental Research Papers**
Edward A. Lewis and Paul A. Kossey 16 Jun. 1975 21 p refs
(AF Proj. 4603)
(AD-A014787; AFCRL-TR-75-0338; AFCRL-ERP-518) Avail: NTIS CSCL 20/14

A simple integral formulation is given for the radio wave power propagating between the curved earth and the ionosphere for the case of low frequency transmitters on the surface of the earth. By making assumptions about the vertical field profiles, the field strengths at arbitrary distances and altitudes can be estimated. Field strength versus distance predictions are compared with published mode and wave-hop calculations and with experimental data. GRA

**N76-16327#** Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
**ANALYSIS OF RADIATION BY WIRE ANTENNAS OVER IMPERFECT GROUND**
Tapan K. Sarkar and Bradley J. Strait 1 May 1975 77 p refs
(Contract F19628-73-C-0047; AF Proj. 5635)
(AD-A014848; AFCRL-TR-75-0337; SR-6) Avail: NTIS CSCL 09/5

Three user-oriented computer programs are presented and described for analyzing radiation from arrays of parallel vertical wires, parallel horizontal wires, and also arbitrary wire configurations over the surface of an imperfectly conducting earth. The first two programs are equipped to treat unequally spaced arrays of wires that can be of different lengths and radii and of arbitrary excitation and loading. The effects of the imperfectly conducting earth are accounted for in an essentially exact manner by using the Sommerfeld formulation. The third program treats arbitrary wire antennas and incorporates the ground effects approximately by using the reflection-coefficient method. Computed output consists of current distribution, input impedances, and field patterns specified by the user. GRA

**N76-16328#** Raytheon Co., Bedford, Mass. Missile Systems Div.
**BROAD BAND ANTENNA STUDY Final Report, 7 Jan. 1972 - 31 Mar. 1975**
Lawrence R. Lewis and Jerome Pozgay Mar. 1975 146 p refs
(Contract F19628-72-C-0202; AF Proj. 4600)
(AD-A014862; BR-8553; AFCRL-TR-75-0178) Avail: NTIS CSCL 09/5

The subject material may be classified in three separate topics. These are: the analysis of dielectric slab-covered waveguide arrays on large cylinders (extended array coverage), scattering from dielectric-covered periodic screens of small rectangular apertures (broadband antenna/radome technology), and the analysis of a stripline fed notch antenna and antenna array (broadband antennas). The report briefly summarizes the first two study areas where detailed accounts are included in Scientific Report No. 1 (AFCRL-73-0587) and Scientific Report No. 2 (AFCRL-74-0173). The investigation of the notch antenna and notch antenna arrays for broadband application are the primary subject material covered in the report. GRA

**N76-16329#** Naval Postgraduate School, Monterey, Calif.
**THE PREPARATIONS FOR AND THE IMPLICATIONS OF THE GENERAL WORLD ADMINISTRATIVE RADIO CONFERENCE OF 1979 M.S. Thesis**
Martha Jane Wheaton Sep. 1975 86 p refs
(AD-A017531) Avail: NTIS CSCL 17/2

In 1979 the International Telecommunication Union (ITU), one of the oldest and most specialized agencies of the United Nations, will convene an Administrative Conference to review and revise, as necessary, the Radio Regulations in their entirety. This is the first time since 1959 that a GWARC will have been empowered to treat the Radio Regulations as a whole. With the world's radio telecommunications expanding by quantum leaps, the competition for frequency allocations can be expected to be fierce. To make matters worse, ITU, like the United Nations, is a 'one nation, one vote' forum. Many countries, mostly the lesser developed ones of the Third Bloc, have started using their votes for political gains during the last few conferences. This thesis proposes to outline the trends seen arising from the last few WARCS in an effort to predict what problems the United States is apt to face in 1979. It also outlines the preparationss presently under way within the United States for this conference and presents recommendations toward the direction it feels these preparation must go for a favorable outcome in the 1979 negotiations. Author (GRA)

**N76-16330#** Rome Air Development Center, Griffiss AFB, N.Y.
**INTERMODULATION REDUCTION IN VHF COMMUNICATIONS SYSTEMS Technical Report, Oct. 1973 - Jun. 1975**
John E. Erickson Sep. 1975 62 p
(AD-A017486; RADC-TR-75-224) Avail: NTIS CSCL 17/2

The report describes the results of an effort to develop hardware that can be used to reduce Intermodulation Product (IMP) generation in VHF Communication Systems. The program consisted of two tasks: the development of a production prototype of an Intermodulation Reduction Device (IRD) using a cancellation technique to achieve IMP reductions, and the development of a fully distributed VHF circulator. GRA

# 33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

**N76-16331*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**FREQUENCY MEASUREMENT BY COINCIDENCE DETECTION WITH STANDARD FREQUENCY Patent**
Edward J. Nossen (RCA, Princeton, N. J.) and Eugene R. Starner, inventors (to NASA) (RCA, Princeton, N. J.) Issued 2 Dec. 1975 4 p Filed 13 Sep. 1974 Supersedes N75-13124 (13 - 04, p 0405) Sponsored by NASA
(NASA-Case-MSC-14649-1; US-Patent-3,924,183; US-Patent-Appl-SN-505819; US-Patent-Class-324-79D; US-Patent-Class-328-134) Avail: US Patent Office CSCL 09C

A method of measuring a desired frequency by comparing it with a standard frequency is disclosed. The zero crossings of both frequencies are detected. A command pulse is generated

at each coincidence and is used to start and stop a pair of frequency counters adapted to count the desired and standard frequencies. A measure of the desired frequency is obtained by multiplying the known standard frequency by the ratio between the desired count and the standard count obtained in the two frequency counters. Official Gazette of the U.S. Patent Office

**N76-16332*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HIGH VOLTAGE DISTRIBUTOR Patent**
James F. McChesney, Jr., inventor (to NASA) Issued 6 Jan. 1976 4 p Filed 15 May 1974 Supersedes N74-22873 (12 - 14, p 1654)
(NASA-Case-GSC-11849-1; US-Patent-3,931,456; US-Patent-Appl-SN-470428; US-Patent-Class-174-145; US-Patent-Class-174-148; US-Patent-Class-339-143C; US-Patent-Class-339-198R; US-Patent-Class-339-242; US-Patent-Class-339-275R) Avail: US Patent Office CSCL 09A

A high voltage distributor which allows the easy connection and disconnection of a high voltage power supply to and from one or more circuits requiring the supply is described. The design configuration features unrestrained pump-out, insulation of the high voltage from ground, and freedom from corona. These features are obtained by mounting a removable retaining rod on one or more insulators, thereby facilitating the support by the retaining rod of a plurality of washers. One of the washers is integrally connected to the high voltage power supply while the remaining washers are integrally connected to the circuits requiring the high voltage. Official Gazette of the U.S. Patent Office

**N76-16333** Saskatchewan Univ., Saskatoon.
**ON THE DYNAMIC BEHAVIOUR OF DUAL-EXCITED SYNCHRONOUS MACHINES Ph.D. Thesis**
Mohamad Abd El-Raheim Mohamad Badr 1974 305 p
Avail: Univ. Microfilms Order No. 76-728

A mathematical treatment is presented which involves a series of digital, analytical and analog simulations, both rigorous and simplified. Information regarding the phenomenon of self-excitation and electromechanical oscillations of dual excited synchronous machines, particularly when they are connected through series compensated transmission lines, are presented. These dynamic stability investigations were followed by a study of the transient stability characteristics of the machines. Especially considered was the effect of the different modes of operation, the loading conditions, the possible schemes of excitation control and the parameters of the control loops on their transient stability limits. Another important aspect considered was the development of generalized equivalent circuits for the machines.
Dissert. Abstr.

**N76-16334** Arizona Univ., Tucson.
**THREE-DIMENSIONAL ANALYSIS OF ELECTROTHERMAL INTEGRATED CIRCUITS Ph.D. Thesis**
Mir Turab Ali 1975 134 p
Avail: Univ. Microfilms Order No. 76-1400

An attempt is made to apply the method of finite elements to the analysis of electro-thermal circuits (ETC). Then a detailed three-dimensional analysis of the ETC is carried out by the method of Green's Function. A general expression for the ETC transfer function is derived, which also contains an impedance boundary condition on the top surface of ETC. A computer program is developed which evaluates the frequency response of an arbitrary configuration of uniform rectangular sensors and heaters. A general expression for the transfer function for a multi-layered ETC is derived. Experimental frequency response measurements agree with the predicted responses. Particularly small and nearly cubical ETC's with dimensions of the order of the thickness of silicon chips have been fabricated and their frequency and response measurements are given. These experimental measurements display the three-dimensional effects predicted by the theoretical results. Dissert. Abstr.

**N76-16335*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**ELECTRODYNAMICS OF LONG CONDUCTING TETHERS IN THE NEAR-EARTH ENVIRONMENT Interim Report**
M. Dobrowolny, G. Colombo, and M. D. Grossi 5 Jan. 1976 22 p refs
(Contract NAS8-31678)
(NASA-CR-144153) Avail: NTIS HC $3.50 CSCL 09C

An analytical approach was developed to evaluate the electrodynamic interactions affecting a thin, bare metallic wire moving in the ionosphere. The wire's diameter was smaller than the Debye length; therefore, the plasma sheath around the wire was taken into account in computing inducing drag force and torque. Computer programs were prepared for the numerical evaluation of mathematical functions that were required to compute the distribution of the potential along the wire and of the current in the wire. Numerical calculations based on this software are shown. Author

**N76-16336#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**THE USE OF INTEGRATED CIRCUITS FOR AMPLIFICATION AND DISCRIMINATION IN ELECTRONICS FOR DRIFT CHAMBERS**
L. Papadopoulos, C. Bosio, and M. Cordelli 3 Oct. 1974 20 p refs
(ISS-T-74/11) Avail: NTIS HC $3.50

The MECL integrated differential amplifier was used to design a fast amplifier stage, which can be repeated in cascade in dc connection if higher gain is desirable. Such a stage where the MC 10216 is used gives an x3 amplification with a rise time (20-80 percent) better than 1.7 ns. The same MECL integrated circuits are used to design a series of discriminators. In all of them a tunnel diode was used, as a trigger element, because of its very low trigger level. Output pulses can be either positive or negative and single or complementary, of an amplitude of 0.850 V and width variable up to some nsec. The pulses are compatible to standard NIM. A repetition rate as high as 40 MC/s is obtained, but in some versions a long dead time was the goal. Rise and fall times are as predicted in the manufacture data book. Author

**N76-16337*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.
**MUCH DISCUSSED ELECTRIC VEHICLE: WILL IT BECOME A REALITY?**
J. Gallot Washington NASA Dec. 1975 17 p Transl. into ENGLISH from Materiaux et Tech. (France), v. 62, no. 11, Nov. 1974 p 467-472
(Contract NASw-2789)
(NASA-TT-F-16834) Avail: NTIS HC $3.50 CSCL 09C

In light of the energy crisis and increasing pollution in urban areas of France, electric engines as an alternative to internal combustion engines as means for powering vehicles are considered. A brief review of the history of electric vehicles (in Europe) dating back to 1881 is given, and the present state of technology and prospects for the future are discussed in some detail. The conclusion reached is that, pending any technological breakthroughs, particularly with regard to fuel cells, electric engines should be based on lead batteries. Such vehicles are currently economically feasible for restricted uses and markets, and their development and large-scale production should be encouraged, despite the fact that they are not suited for all needs. Author

**N76-16338#** Sandia Labs., Albuquerque, N.Mex.
**LOW VOLTAGE INITIATION OF DAMAGING ARCS BETWEEN ELECTRICAL CONTACTS**
R. E. Cuthrell Jul. 1975 27 p refs
(Contract AT(29-1)-789)
(SAND-75-0103) Avail: NTIS HC $4.00

Metallic arcs were found to precede the firm contacting of electrical contacts which were closed without bounce. When the open-circuit voltages were below the ionization potential, the initiation of these arcs was found to depend on the presence of asperities on the surfaces and on asperity contracting, melting, and pinching off by magnetic forces. The arc is thought to be initiated inductively when the molten metallic asperity contact is pinched off, and the electrode damage is similar to that produced by the arcing of opening contacts. Arcing could not be produced for exceptionally smooth surfaces, or, for rough surfaces when the open-circuit potential was below the melting voltages of the electrode metals. In order to prevent damage to contact surfaces by melting or arcing, it is suggested that test potentials be limited to below the melting voltages, that the current be limited,

the test circuits be designed to prevent inductively generated high voltage transients, and the contract surfaces be very smooth. Author (NSA)

**N76-16339#** Brookhaven National Lab., Upton, N.Y.
**CONSIDERATIONS OF VOLTAGE DROP AND LOSSES IN THE DESIGN OF HELICALLY-WOUND SUPERCONDUCTING AC POWER TRANSMISSION CABLES**
G. Morgan and E. B. Forsyth 1975 15 p refs Presented at the Intern. Cryogenic Mater. Conf., Ontario, Can., 22 Jul. 1975 Sponsored in part by ERDA and NSF
(BNL-19849; Conf-750716-3) Avail: NTIS HC $3.50

Flexibility in a cable made using brittle superconductors is obtained by winding the superconductor and electrical insulation in the form of concentric helices. The axial stress due to contraction during cooldown of a helix which is rigidly attached at each end is reduced compared to a seamless tube. The radial contraction of the conductor is adjusted by selection of the pitch to match the greater contraction of the dielectric material. A choice of pitch for a simple helix which satisfies the contraction condition will, in general, generate an axial field in its interior which causes heating in any normal metal there, induces currents in metal surrounding the cable (e.g., armor) and causes an inductive voltage drop in the shield helix. A general expression for the self and mutual inductances of concentric helices is given and it is shown that the only configuration which minimizes heating and voltage drop consists of a core and shield each wound from a double helix, one inside the other and having almost equal pitches but opposite sense of winding. Author (NSA)

**N76-16340#** Helsinki Univ. of Technology, Otaniemi (Finland). Radio Lab.
**AN ANALYTICAL MODEL OF A TRANSFERRED ELECTRON DEVICE**
David E. Meharry 1974 33 p refs
(Rept-S-68; ISBN-951-750-388-1) Avail: NTIS HC $4.00

A model of quenched domain oscillations in a transferred electron device was developed, the final results being algebraic expressions for device admittance (negative conductance and susceptance) as a function of bias voltage, temperature, frequency, and output power. The starting point was a piecewise linear approximation to the static velocity-field characteristic of n-GaAs, the various parameters having an appropriate temperature dependence. The dynamic behavior of a high field domain in a material displaying this characteristic was examined assuming only that diffusion effects were negligible. A current; voltage characteristic resulted which was appropriate to the case of quenched domain mode oscillations. Using this characteristic, the voltage and current waveforms were determined and were finally Fourier analyzed to obtain the device admittance. The model can be applied to the analysis of various microwave oscillator circuits to study the effects of temperature variations or bias changes on output power and frequency. Author (ESA)

**N76-16341#** Bundesministerium der Verteidigung, Bonn (West Germany).
**EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON LABORATORY MODELS OF PHASED ARRAY ANTENNAS [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN AN LABORMODELLEN VON PHASED ARRAY ANTENNEN]**
H. Lueg DOKZENTBw 1975 40 p refs In GERMAN; ENGLISH summary
(BMVG-FBWT-75-4) Avail: NTIS HC $4.00; DOKZENTBw, Bonn DM 30

Investigations on a linear and a planar array of waveguide fed aperture antennas, scanned in X-band are discussed. A complete array of 9 steerable antennas was constructed and it's scanning ability was verified experimentally. Theoretical and experimental work on the components of planar arrays resulted in numerical and experimental methods for the analysis of planar array antennas. Injection locked oscillators for active antenna modules were investigated and suitable Gunn oscillators were realized in microstrip technique. It is shown that feeding-networks can be realized with reactance-networks, giving a satisfactory behavior of the corresponding array. Author (ESA)

**N76-16342#** AEG-Telefunken, Ulm (West Germany).
**DEVELOPMENT OF A TRAVELING WAVE TUBE FOR SATELLITE COMMUNICATION WITHIN THE FREQUENCY RANGE 11.7 - 12.5 GHz WITH A SATURATION OUTPUT POWER OF 700 W [ENTWICKLUNG EINER WANDERFELD-ROEHRE FUER SATELLITEN-BORDBETRIEB IM FREQUENZBEREICH 11,7 - 12,5 GHz MIT EINER SAETTIGUNGSAUSGANGSLEISTUNG VON P = 700 W]**
Dieter Deml, Karl-Heinz Bluhm, Hartmut Radlinger, and Franz Dlouhy Bonn Bundesmin. fuer Forsch. und Technol. Sep. 1975 123 p refs In GERMAN; ENGLISH summary
(Contracts BMFT-RFT-5007; GfW-RV-11-QH-6/72)
(BMFT-FB-W-75-17) Avail: NTIS HC $5.50; ZLDI, Munich DM 25.50

A Traveling Wave Tube (TWT) was designed for a TV broadcast satellite transmitter with the following features: a modified Pierce electron gun with beam area compression of 1:120 and an integrated dispenser type cathode with loading of 0.7 A/sq cm; a coupled cavity resonator delay line with an integrated ppm type guidance system comprising SmCo5 magnets; and an extremely low thermal resistance inside the tube. Results of a low gain tube (15 db) and a high gain tube (46 db) are given. Life behavior was estimated from extensive cathode life experiments, and it is concluded that all requirements set for the development of the TWT were met. ESA

**N76-16343#** Maxwell Labs., Inc., San Diego, Calif.
**HIGH POWER SPARK GAP SWITCH DEVELOPMENT Final Technical Report, 1 Apr. 1974 - 31 Mar. 1975**
Wayne Clark May 1975 78 p refs
(Contract F33615-74-C-2027; AF Proj. 3145)
(AD-A015072; AFAPL-TR-75-41) Avail: NTIS CSCL 09/1

A pressurized spark gap switch is described which is capable of high repetition rates in the multi-megawatt average power range. This switch uses air flow to remove the hot gas generated by the conduction current. A two electrode pair version of this switch has been operated at repetition rates up to 500 pps and simulated average power levels up to 5.6 megawatts in bursts of several seconds with an air flow of approximately 150 CFM per electrode pair. The switch was tested using a simulation technique which duplicates the high power electrical waveforms experienced by the switch but requires less operating power than is transferred to the load under acutal operating conditions. GRA

**N76-16344#** Texas Instruments, Inc., Dallas. Central Research Labs.
**ACOUSTIC RIDGE WAVEGUIDE TECHNOLOGY Semiannual Technical Report, 6 Jan. - 30 Jun. 1975**
Robert S. Wagers Aug. 1975 37 p refs
(Contract N00014-75-C-0317; ARPA Order 2827)
(AD-A014651; TI-08-75-30) Avail: NTIS CSCL 09/1

The report presents results obtained during the first six months of development of acoustic waveguides. A primary motivation for developing acoustic waveguides is to take advantage of the potential size reduction over current surface acoustic wave technology. Waveguide components represent the next step in microminiaturization of acoustic signal processing devices. Devices that may be developed include directional couplers, ring resonators, and serial memory. In addition, because of the high degree of spatial confinement of the acoustic energy, nonlinear and acousto-optic interactions become possible. GRA

**N76-16345#** Westinghouse Defense and Electronic Systems Center, Baltimore, Md. Development Div.
**BINARY-ADDRESSABLE SCAN CONVERSION STORAGE TUBE Final Report, 15 Oct. 1971 - 31 Dec. 1973**
H. J. Bourg Apr. 1975 213 p refs
(Contract DAAB07-72-C-0052)
(AD-A015029; ECOM-72-0052-F) Avail: NTIS CSCL 09/1

The objective of the contract was to conduct a research and development program leading to the fabrication, testing, and delivery of a binary-addressable scan converter storage tube. The device was to be capable of simultaneous write and non-destructive read operation at video frequencies up to 10 megahertz. A major portion of the effort was devoted toward fabrication of perforated switch-plates. The final device requires six such plates. Each plate had a 512 x 512 array of 0.001

inch-diameter holes on 0.003 inch centers and a unique control-electrode geometry which allowed selection of any one of the holes in the array. The remainder of the effort was devoted toward fabricating a storage target which prevented cross-talk between the reading or writing beams. This target was made up of any array of gold plugs uniformly dispersed in an Al2O3 substrate such that a single plug was aligned to each hole or electron lenslet in the digitizing matrix. A prototype device was fabricated and operated. It proved the feasibility of fabricating the digitizing matrix and maintaining alignment from switch-plate to switch-plate. In addition, it pointed out several shortcomings of the double-ended gun design, in that flood-gun currents were too low and field-flattening mesh capacities were much too high for 10 megahertz operation. Other possible techniques of supplying the flood-beam to the digitizer-stack are discussed. GRA

**N76-16346#** Spectronics, Inc., Richardson, Tex.
**OPTOELECTRONIC DEVICES PACKAGED FOR FIBER OPTICS APPLICATION, VOLUME 2 Final Technical Report, May 1974 - May 1975**
R. S. Speer Indianapolis, Ind. Naval Avionics Facility Aug. 1975 44 p
(Contracts N00163-74-C-0308; N00163-73-C-0544)
(AD-A014652; NAFI-TR-2073-Vol-2) Avail: NTIS CSCL 09/1

The work was devoted to the development of fixtures and techniques for positioning and soldering the optoelectronic components into the termination assembly hardware. The termination assembly hardware was designed to insure proper positioning of the fiber optic terminating ferrule relative to the optoelectronic components, to constrain the terminating ferrule, to insure reliable optical coupling, and to provide adequate thermal dissipation for the LED. The termination assembly hardware is also compatible with standard military avionics connector systems. Using this hardware it is possible to mix power cables, coax cables, and fiber optic data lines in the same connector and wire harness. GRA

**N76-16347#** Microwave Associates, Inc., Burlington, Mass.
**PRODUCTION ENGINEERING MEASURE FOR HIGH BURNOUT RESISTANT MIXER DIODES Quarterly Progress Report, 1 Feb. - 30 Apr. 1975**
Y. Anand Aug. 1975 52 p
(Contract DAAB05-73-C-2065)
(AD-A014880; ECOM-2065-8-75; QPR-8) Avail: NTIS CSCL 09/1

The object of this program is to develop the processes, techniques and manufacturing methods to manufacture S, X and Ku-band high burnout resistant mixer diodes. These diodes are to be used as replacements for 1N21, 1N23 and 1N78 type point contact diodes in existing S, X, and Ku-band Schottky-Barrier diodes were manufactured and were characterized for their RF performance. Author (GRA)

**N76-16348#** California Univ., Los Angeles. School of Engineering and Applied Science.
**FABRICATION OF A POWER SUPPLY SYSTEM AND CHARACTERIZATION OF AMORPHOUS SEMICONDUCTORS Final Technical Report, 18 Mar. - 31 Dec. 1974**
John D. MacKenzie 31 Dec. 1974 87 p refs
(Contract N00123-74-C-0375)
(AD-A014678) Avail: NTIS CSCL 09/1

Threshold switches based on amorphous semiconductors possess a number of attractive features if they are easily fabricable and do not deteriorate with time. Extensive review of the literature and theoretical considerations suggest that such switches can be conveniently fabricated and that some materials can be stable even after long periods of usage. Preliminary experimental work was undertaken to evaluate the most promising materials and fabrication method. Oxide glasses based on V2O5 and P2O5 were prepared and compounded into the form of ink. Thick film technique was used to prepare switches. A power supply system was then designed and fabricated incorporating amorphous semiconductor switches. Results indicated that such switches have long-term stability and can show satisfactory performance in power supply systems. GRA

**N76-16349#** Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
**THEORY AND DESIGN OF ELECTRICAL ROTATING MACHINERY Annual Report, 1 May 1974 - 30 Apr. 1975**
W. J. Carr, Jr. Jul. 1975 18 p refs
(Contract N00014-72-C-0432; NR Proj. 097-385)
(AD-A014624; AR-3) Avail: NTIS CSCL 09/3

The objective of the program is to contribute toward new and improved rotating machines for Naval applications, with emphasis on superconducting machinery. Work has been performed on the theory of a.c. losses in multifilament superconductors and experiments were made to check the theory. A list of publications and abstracts of scientific papers published under the contract is given. A smaller amount of work was done in studying a superconducting heteropolar d.c. motor. GRA

**N76-16350#** National Bureau of Standards, Washington, D.C. Center for Building Technology.
**MODIFICATION OF FLUORESCENT LUMINAIRES FOR ENERGY CONSERVATION Technical Note, 1 Mar. - 30 Apr. 1975**
Robert W. Beausoliel, William J. Meese, and Gary Yonemura Oct. 1975 18 p ref
(COM-75-11365/4; NBS-TN-886) Avail: NTIS HC $3.50 CSCL 13A

Reducing energy consumption in existing buildings by reducing the number of lamps presents technical problems when more than one fluorescent lamp operates from a single ballast. A preliminary investigation was made whereby capacitors were substitued for one fluorescent lamp in a two-lamp luminaire which operated with a single ballast. Under optimum conditions, lighting efficiency (foot-candles per watt) was nearly as high at reduced power input as it was with two lamps operating normally. No failures in lighting equipment or capacitors occurred and no fire hazards, other safety hazards or other unsatisfactory occurrences were observed. A more thorough investigation involving a number of parameters is needed to ascertain the feasibility of this modification. GRA

**N76-16351#** Monsanto Research Corp., Dayton, Ohio.
**ARC PLASMA SPRAYED MICROWAVE CIRCUITS Final Report, 1 Jul. 1974 - 31 Mar. 1975**
D. H. Harris Aug. 1975 60 p refs
(Contract DAAB07-74-C-0636; DA Proj. 1T7-62705-A-348)
(AD-A015077; MRC-DA-489; ECOM-74-0636-F) Avail: NTIS CSCL 09/5

Gold, copper, aluminum, and aluminum -4.5%(wt.) copper alloy were deposited as microwave integrated circuit metallizations on alumina substrates by arc plasma spraying. Metallization by arc plasma spraying was investigated as an economical method for metallizing ceramic substrates for MIC's and other devices. The emphasis was on simplicity of operation for cost effectiveness over present metallization techniques. The arc plasma and anneal conditions were optimized for each metal type and the resulting films were characterized for d.c. resistivity, microwave Q, and adherence. Copper and gold films exhibited the best overall electrical performance, matching or exceeding the performance of commercially prepared films. The adherence of all metallizations generally exceeded the intrinsic strength of alumina substrates. Aluminum and aluminum-copper alloy metallizations were found to present bonding and soldering complications, making them less cost effective. GRA

## 34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

**N76-16352** Purdue Univ., Lafayette, Ind.
**UNSTEADY NATURAL CONVECTION OF A VERTICAL PLATE Ph.D. Thesis**
Fun-Pei Yau 1975 197 p
Avail: Univ. Microfilms Order No. 76-605

An analytical and numerical study is presented of the problem

of the unsteady two-dimensional, boundary layer flow which is generated by natural convection when a vertical plate is suddenly heated to a temperature above the ambient temperature. The basic objectives were to obtain a complete numerical solution for the entire velocity and temperature fields and provide a better qualitative and quantitative understanding of the transition region. Dissert. Abstr.

**N76-16353** Cincinnati Univ., Ohio.
**FLOW PATTERNS AND PRESSURE DROP IN HORIZONTAL TWO-PHASE PIPE FLOW Ph.D. Thesis**
Whee Ghee Choe 1975 272 p
Avail: Univ. Microfilms Order No. 76-724

The relationship between flow patterns and frictional pressure drop during cocurrent gas-liquid flow in horizontal pipelines was studied. Key flow pattern transitions were identified: (1) onset of homogeneous flow, (2) onset of separated flow and (3) intermittent-annular transition. Two theoretical models to the intermittent-annular transition are examined. The models were developed on the basis (a) a wave mechanism and (b) entrainment-deposition mechanism. The wave model was considered to provide the most satisfactory correlation of the data. On the basis of these correlations an overall flow pattern map was proposed. The two-phase pressure drop correlations were compared to the world data on two-phase pressure drop. It is found that an appreciably better fit of two-phase pressure drop in horizontal tubes can be obtained when separate correlations were used for the various flow pattern regions. Dissert. Abstr.

**N76-16354** North Carolina State Univ., Raleigh.
**COMBINED RADIATIVE AND CONVECTIVE HEAT TRANSFER TO LAMINAR FLOW IN A FLAT CONDUIT Ph.D. Thesis**
Michael Charles Cullingford 1975 137 p
Avail: Univ. Microfilms Order No. 76-899

Heat transfer to laminar fluid flow between parallel plates with combined radiation and convection was solved with an approximate analysis, and the effects of optical thickness, axial distance and the conduction-to-radiation parameter on the Nusselt number were investigated. The accuracy of the solution was checked by applying the present method of solution to the slug flow problem between parallel plates for which an exact solution is available. Results were compared with those obtained by other investigators by purely numerical methods of solution. These comparisons show that the present method is sufficiently accurate when the conduction-radiation interaction is weak. The results are shown to be valid over a larger range of distance from the channel entrance when the conduction-radiation interaction is weak. Dissert. Abstr.

**N76-16355** Iowa State Univ. of Science and Technology, Ames.
**STUDIES OF SCALAR TURBULENCE IN AIR DOWNSTREAM OF A HEATED GRID Ph.D. Thesis**
Richard Alan Martin 1975 261 p
Avail: Univ. Microfilms Order No. 76-1859

The problem of turbulent mixing of scalar properties is addressed. The results of an experimental study of density or temperature fluctuation statistics made in the low speed flow field produced by a heated grid suporting velocity fluctuation statistics are also included. Data were collected in both the isotropic and nonisotropic regions using two measuring techniques. As the primary technique a crossed-beam schlieren (CBS) was applied. This optical, remote sensing device uses two orthogonal laser-schlieren systems and a cross correlation data analysis procedure to obtain local measurements of scalar fluctuations. As the secondary technique a constant temperature HWA was operated in three modes. High overheats were used to obtain velocity statistics in isothermal flow. The resistance thermometer and multiple-overheat (mixed-sensitivity) modes were used to obtain temperature and velocity statistics in non-isothermal flow. Included is a detailed discussion of HWA calibration procedures for temperature fluctuation measurements. Dissert. Abstr.

**N76-16356** California Inst. of Tech., Pasadena.
**EXPERIMENTAL STUDIES OF THE NOISE PRODUCED IN A SUPERSONIC NOZZLE BY UPSTREAM ACOUSTIC AND THERMAL DISTURBANCES Ph.D. Thesis**
Jerome Martin Auebach 1975 275 p
Avail: Univ. Microfilms Order No. 75-19991

A noise source mechanism whereby sound is produced by time-dependent temperature nonuniformities in a flow with a mean velocity gradient was investigated experimentally. A steady accelerating flow was produced in a rectangular supersonic nozzle with an entrance Mach number of 0.2, an exit Mach number of 1.38, and a throat area of 1 in. sq. A rotary valve bleed flow system and an electrical wire resistance heater upstream of the nozzle introduced mass flow and temperature fluctuations into the nozzle flow at frequencies up to 500 Hz. Sound measurements were made at six positions along the nozzle and outside the nozzle assembly, which was enclosed in an anechoic chamber 10 ft. on a side. All data acquisition and processing was done with a computer-controlled data acquisition system. By interfacing the control circuitry of the bleed flow and heater systems to the data acquisition system, a digital signal-averaging technique was developed which enabled the sound produced by the bleed flow and temperature fluctuations to be detected and accurately measured in high-level backgrounds of turbulent flow noise. Dissert. Abstr.

**N76-16357#** Advisory Group for Aerospace Research and Development, Paris (France).
**IMPROVED NOZZLE TESTING TECHNIQUES IN TRANSONIC FLOW**
A. Ferri, ed. Oct. 1975 384 p refs In ENGLISH and FRENCH Conf. held at Rome, 4-10 Sep. 1974
(AGARD-AG-208; AGARDograph-208) Avail: NTIS HC $10.75

Conference papers on international testing of nozzle designs and performance at transonic flow are summarized. Data cover the effects of experimental techniques used, influence of various jet parameters-static pressure distribution, temperature, pressure drag, boattail drag, and jet exhaustion nozzle performance. For individual titles, see N76-16358 through N76-16371.

**N76-16358** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**ONERA: EXPERIMENTAL STUDY OF 15 DEG. STANDARD AGARD NOZZLE IN SUBSONIC AND TRANSONIC FLOW [ETUDE EXPERIMENTALE DE LA TUYERE ETALON AGARD 15 DEG. EN ECOULEMENTS SUBSONIQUE ET TRANSSONIQUE]**
B. Mechin *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 52 p refs In FRENCH (For availability see N76-16357 07-34)

A test facility designed to study the performance of a standard 15 deg AGARD nozzle at subsonic and transonic flow is described. Data studied include the effects of sound, pressure, and temperature on internal flow, nature of the boundary layer, performance of the nozzle at a fixed point and with external flow, and static pressure distribution on the exterior surface of the nozzle. Transl. by E.H.W.

**N76-16359** Rolls-Royce, Ltd., Bristol (England).
**DESCRIPTION OF TESTS CARRIED OUT AT ROLLS ROYCE (1971) LTD BRISTOL ENGINE DIVISION**
L. R. Harper *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 22 p refs (For availability see N76-16357 07-34)

Three nozzle afterbody models were tested in the Rolls-Royce (1971) Ltd. transonic wind tunnel at Bristol using a model support sting which provided means for boundary layer thickness variation by blowing. The tests covered the Mach number range 0.75 to 0.95 and nozzle pressure ratios were in the range 1.7 to 4.7:1. The model surface static pressure distributions were measured and integrated to obtain pressure drag coefficients. Measurements are also presented of model internal pressures, boundary layer profiles and tunnel wall static pressure distributions. Author

**N76-16360** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
**AN EXPERIMENTAL STUDY OF THE INFLUENCE OF THE JET PARAMETERS ON THE AFTERBODY DRAG OF A JET ENGINE NACELLE SCALE MODEL**
H. Dissen and A. Zacharias *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 14 p ref (For availability see N76-16357 07-34)

Numerous experimental tests with an engine nacelle scale model were made to investigate the influence of engine jet parameters on the pressure distribution of the engine nacelle and therefore on the boattail pressure drag. Regarding the planned flight tests on the HFB 320 Hansa Jet at the end of 1975, the experimental work was done with a model of the GE CJ 610 engine nozzle, including its nacelle. The influence of jet pressure ratio and jet temperature on the boattail pressure distribution at different flight Mach numbers are shown. The effect of boundary layer control and the influence of changing the internal nozzle geometry on the pressure drag is also investigated. Author

**N76-16361** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).

**CONTRIBUTION OF THE INSTITUT FUER ANGEWANDTE GASDYNAMIK OF THE DFVLR, PORZ-WAHN**

H. Emunds and H. Riedel *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 42 p (For availability see N76-16357 07-34)

The results presented relate to the AGARD models with 10 deg and 15 deg boattail chord angle. They cover the static pressure distributions on the afterbody and wall of the propulsive nozzle as well as the total pressure distributions in the nozzle flow and in the external flow field. The latter was only investigated for the model with 10 deg boattail. From the surface static pressure distributions on the afterbody of the models the boattail pressure drag coefficient was deduced. A cold propulsive jet of air was used, the nozzle total pressure ratio ranging from 1.0 to 6.63. The free stream Mach numbers covered the regime 0.5 < free stream Mach number < 0.96. Author

**N76-16362** National Aerospace Lab., Amsterdam (Netherlands).

**RESULTS OF NLR CONTRIBUTION TO AGARD AD HOC STUDY**

D. Rozendal, C. C. Groothoff, and W. B. G. Derksen *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 41 p refs (For availability see N76-16357 07-34)

A description is given of a series of experiments in order to assess the influence of jet exhaust parameters - total pressure distortion, nozzle pressure ratio, jet temperature (ratio of specific heats) - at transonic Mach numbers in the range of .8 to .96 on the nozzle thrust and discharge coefficients, on afterbody pressure distribution, and on the afterbody pressure drag. A model of .08 m diameter was tested in the .27 x .27 sq m transonic test section of a continuous blow-down wind tunnel. The 15 deg boattailed afterbody configuration as proposed by AGARD was supplemented by an afterbody with a twice as large nozzle area. The fuselage boundary layer thickness was varied by increasing the forebody length. A method was developed to define a valid total pressure, based on a mass flow averaging procedure, for a distorted jet pipe flow. The results for the AGARD nozzle, contraction ratio 3.24, show that in the investigated range of NPR's there is only a small effect due to the jet pipe total pressure distortion, while for the larger nozzle with a contraction ratio of 1.62 the hollow velocity profile, compared to a flat profile, significantly lowered the nozzle discharge coefficient (3.2%), raised the specific thrust +2.1% and changed the afterbody pressure distribution at free stream Mach number = .8. Effects on afterbody pressure distribution and pressure drag due to different NPR and free stream Mach number were evident, while an influence due to fuselage boundary layer thickness is indicated. Author

**N76-16363** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

**EFFECTS OF VARYING REYNOLDS NUMBER AND BOUNDARY LAYER DISPLACEMENT THICKNESS ON THE EXTERNAL FLOW OVER NOZZLE BOATTAILS** **c43**

D. Zonars, James A. Laughrey, and Douglas L. Bowers *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 28 p refs (For availability see N76-16357 07-34)

Data for the 10 deg, 15 deg, and 25 deg AGARD nozzle boattails presented are from those test facilities in which the Reynolds number was varied at constant Mach number or where the boundary layer was varied by blowing or changing the length of the model. Evaluation and discussion of the data concentrates on the trends in pressure drag and static pressure distributions when the external flow conditions (specifically Reynolds number and/or boundary layer displacement thickness) are altered over the Mach number range of 0.8 through 0.95. In general when the Reynolds number was increased or the boundary layer displacement thickness was decreased, the static pressures decreased at the beginning of the boattail (flow expansion region) and increased near the nozzle exit (flow recompression region). The pressure drags associated with these changes in the pressure distributions varied only slightly at 0.8 Mach number, but increased measurably at 0.9 Mach number. Increasing the Reynolds number or decreasing the displacement thickness at a Mach number of 0.95 changed the flow such that the expansion was greater and the recompression was less resulting in a significant increase in pressure drag. The flow separated just downstream of the shoulder on the 25 deg boattail for all Mach numbers investigated and a change in Reynolds number or displacement thickness did not noticeably influence the point at which the flow separated although there was some variation on the level of pressure in the separated zone. Author

**N76-16364** Arnold Engineering Development Center, Arnold Air Force Station, Tenn.

**DESCRIPTION OF THE AGARD NOZZLE AFTERBODY EXPERIMENTS CONDUCTED BY THE ARNOLD ENGINEERING DEVELOPMENT CENTER**

L. L. Galigher, F. M. Jackson, and C. E. Robinson *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 6 p refs (For availability see N76-16357 07-34)

A comprehensive test program, directed toward evaluation of Reynolds number and exhaust plume temperature effects on nozzle afterbody pressure drag, was conducted. Reynolds number effects were obtained by varying both model scale and wind tunnel pressure level. At AEDC, Ethylene(R)/air combustor, installed in the nozzle flow tube, was used to provide hot exhaust products which very closely duplicate the exhaust products of JP-4 burned in air. Ignition was accomplished by injecting a small quantity of tri-ethyl borane (a pyrophoric fuel) into the combustor flameholder. Nozzle afterbody pressure drag, determined from pressure integration, was obtained at freestream Mach numbers of 0.6, 0.8, 0.9, 0.95, 1.1, and 1.5. Reynolds number (based on model length) and nozzle total pressure-to-free-stream static pressure ratio was varied from 2 million to 62 million and from jet-off to a maximum of 22, respectively, depending upon the free-stream Mach number. Fuel/air ratio was varied from 0 to 0.05, which corresponds to an exhaust plume total temperature range from 306 K to approximately 1889 K. Model angle of attack was zero degrees at all test conditions. To evaluate the effect of test section wall porosity on the performance of transonic wind tunnels the walls were modified for wall porosities of 2 and 4 percent in addition to the normal 6 percent, through the Mach number range from 0.6 to 0.95. Author

**N76-16365*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**CONTRIBUTION OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LANGLEY RESEARCH CENTER**

William B. Compton, III and Jack F. Runckel *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 9 p refs (For availability see N76-16357 07-34)

CSCL 20D

As part of a special international effort, three nozzles were designed and tested on single nacelle models in wind tunnels of several nations belonging to the North Atlantic Treaty Organization. All three of these nozzles were investigated in the Langley 16-foot transonic wind tunnel at the National Aeronautics and Space Administration's Langley Research Center. Langley Research Center also contributed theoretical calculations of the jet plume boundary and afterbody pressures. The calculations were obtained using an iterative solution which combined the inviscid Douglas Neumann method for the external flow with the method of characteristics for the flow in the jet plume. For the investigation, the nozzles were mounted on a single nacelle model 15.24 centimeters in diameter and 162.56 centimeters long. Tests were made at free stream Mach number from 0.4 to 1.2, and at Reynolds numbers per meter from 7.38 million to 13.78 million depending on the Mach number. Four types of data were recorded: afterbody pressure data, afterbody force data, model boundary layer data, and tunnel wall pressure data. The ratio of jet total pressure to free stream static pressure

ranged up to 8.5. A description of the wind tunnel, model, and test procedure is included. Author

**N76-16366** Rolls-Royce, Ltd., Bristol (England).
**THE INFLUENCE OF MODEL EXTERNAL GEOMETRY**
L. R. Harper and W. J. Lewis *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 11 p refs (For availability see N76-16357 07-34)

The results of model tests of three axisymmetric afterbodies in a number of different wind tunnels were examined in terms of the influence of model external geometry. The variation of drag with afterbody geometry was shown to be in accord with the trend for drag to increase and drag rise Mach number to decrease as the body is made less slender. It is found that drag and drag rise Mach number can be correlated quite well with boattail chord angle for a wide range of afterbody geometries in addition to those tested in this exercise. Increase of boundary layer thickness was shown to decrease the effective curvature of the afterbody. At speeds below the drag rise Mach number for any particular geometry this modifies the afterbody pressure distribution but has little effect on the pressure drag. Above the drag rise Mach number drag coefficients measured with a boundary layer thickness typical of model test conditions were about 0.01 lower than when the boundary layer thickness was reduced to a value typical of flight conditions. Comparison of results obtained in various wind tunnels covering blockage ratios from 0.2% to 7% failed to show any discernable effect of tunnel interference at least for Mach numbers up to about 0.9 to 0.95. At high blockages static pressure varies considerably along the tunnel wall and it becomes crucial to select a reference static pressure which is substantially free from the influence of the afterbody pressure field. The overall conclusion is that results obtained in the various facilities are in good agreement and the techniques of afterbody drag measurement in current use are generally satisfactory although correct simulation of boundary layer thickness is sometimes necessary. Author

**N76-16367** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**INFLUENCE OF THE JET PRESSURE RATIO ON THE PERFORMANCE OF AN AGARD SINGLE FLOW AFTERBODY IN THE 0.60-0.95 MACH RANGE**
Bernard Mechin and Jean-Marie Hardy *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 8 p refs In FRENCH; ENGLISH summary (For availability see N76-16357 07-34)

The synthesis of experimental data concerning the effect of jet stagnation conditions on the drag of various afterbodies is presented. Jet pressure ratio effect on boattail pressure and on boundary layer separation is analyzed. This study is made for several values of the boundary layer thickness, taking into account the fact that some test rigs make its control possible by means of tangential blowing. Author

**N76-16368** National Aerospace Lab., Amsterdam (Netherlands).
**INFLUENCE OF JET PARAMETERS: NOZZLE THRUST AND DISCHARGE COEFFICIENTS**
C. C. Groothoff *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 22 p refs (For availability see N76-16357 07-34)

Internal flow and nozzle characteristics were analyzed. All available data were used in a comparison of the nozzle discharge and thrust coefficients and jet pipe wall static pressures of similar model configurations. It was found necessary to take into account the distortion of the total pressure profiles in the jet pipe. The mass flow averaged total pressure was used in the calculations. The distortion coefficient DCM proved to be a useful tool in the comparison of the mass flow averaged total pressure with the 1-D isentropical total pressure, derived from mass flow, temperature and static pressure. The discharge coefficients that were found in the range of nozzle pressure ratios of about 1.3 to 12 were in good agreement. For the specified nozzle A the discharge coefficient Cd = .986. For this nozzle configuration with a contraction ratio of 3.24 hardly any influence on Cd of jet medium or distortion was found. External air flow did influence Cd, mainly through the boattail overpressure near the nozzle lip. The thrust coefficients were found to be difficult to compare, one set of data however shows an inexplained higher level (about 1 - 2%). Nozzle B (contraction ratio 1.62) showed more influence of distortion in the jet flow. The values for the choked nozzle discharge coefficients were Cd = .978 (no dist.) and Cd = .946 (dist.). Distortion was also found to influence the wall static pressures in the jet pipe. Author

**N76-16369** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
**INFLUENCE OF JET PARAMETERS: BOATTAIL PRESSURE DISTRIBUTION AND PRESSURE DRAG**
H. Dissen, H. Emunds, H. Riedel, and A. Zacharias *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 17 p refs (For availability see N76-16357 07-34)

Preliminary results are presented of the influence of the jet parameters on the boattail pressure distribution and on the boattail pressure drag with reference to the AGARD models and a model of the HFB 320 engine nacelle. The jet parameters investigated were the jet temperature, the wake and jet mixing, the internal nozzle configuration, and the jet distortion. Concerning the influence of jet temperature two contrasting effects were observed. These differences may be due to different surface temperatures and base areas of the models tested. Further investigations as regards these temperature effects seem to be necessary. Very little information has become available on wake and jet mixing, so that in this area further research is also needed. No effect was observed for changes of the internal nozzle geometry and of the jet distortion. Author

**N76-16370** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
**DATA VARIANCE DUE TO DIFFERENT TESTING TECHNIQUES**
J. A. Laughrey, G. K. Richey, and Antonio Ferri, (N. Y. Univ., N. Y.) *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 21 p refs (For availability see N76-16357 07-34)

A comparison of the boattail pressure distributions from data presented earlier shows that there is a significant variance in the data obtained in the various facilities, particularly at 0.9 and 0.95 Mach numbers. The analysis is concentrated on the 15 deg AGARD boattail tested in the 0.8 to 0.95 Mach number range. Differences in model support, model scale, tunnel blockage, tunnel buoyancy, wall type and porosity, and determination of tunnel reference flow conditions are examined in an attempt to understand the disagreement in the data. Model and wall static pressure distributions from various facilities are analyzed to try to isolate the reasons for these differences and to determine if there is a significant effect on the flow over the nozzle boattail. An indication of possible wall interference is obtained by comparing the measured wall static pressure distributions to those determined analytically with a far field boundary condition corresponding to free flight conditions. Author

**N76-16371** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
**FORE- AND AFTBODY FLOW FIELD INTERACTION WITH CONSIDERATION OF REYNOLDS NUMBER EFFECTS**
Felix Aulehla and Geert Besigk *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 22 p refs (For availability see N76-16357 07-34)

Recent aftbody drag results obtained from different transonic wind tunnel measurements showed such large increases in aftbody pressure drag with increasing Reynolds number that extrapolation to full scale became questionable. Attempts made to clarify this unexpected Reynolds number effect with the aim of contributing to improved testing techniques are outlined. An analysis of a wind tunnel investigation at Mach number 0.8 on a series of axisymmetric bodies showed as main result that varying Reynolds number produced in the wind tunnel opposite changes in pressure drag on fore- and aftbody, respectively. It is explained that this result probably was caused by small deviations in free stream static pressure to which part-models are by an order of magnitude more sensitive than complete models. Therefore, unless a wind tunnel is calibrated to considerably better standards than usual it is recommended to take into account the compensating effects on the forebody; the buoyancy corrections due to pressure gradients, however, have to be considered in addition. In the present measurements the changes of the mean wall pressures

seemed to correlate with the corresponding changes on the model and were used as a correction term. Finally it is pointed out that modifications in aftbody geometry affect forebody drag. Results from the commonly used aftbody test rigs with forebodies fixed to the ground therefore need appropriate corrections.
Author

**N76-16372#** Canada Inst. for Scientific and Technical Information, Ottawa (Ontario).
**CONTRIBUTION TO THE STUDY OF THE INSTABILITY OF BUBBLES IN A LIQUID**
A. T. Martinengo 1976 13 p refs Transl. into ENGLISH from Ing. Riv. di Sci. e Tec (Italy), v. 12, 1971 p 745-749
(ISSN-0470-2557; NRC/CNR-TT-1838) Avail: NTIS
The behavior of air and vapor bubbles in aerated water at rest under room temperature conditions was studied. Thermodynamic equilibrium conditions were analyzed, and in this way the value of the critical radius R sub C was determined. This parameter was found to signify a condition of unstable equilibrium for the bubble, inasmuch as any disturbance may produce either its continued growth or its complete collapse. These considerations were then related to the study of the release of the cavitation phenomenon.
Author

**N76-16373#** Toronto Univ. (Ontario).
**AN ANALYSIS OF SHOCK STRUCTURE AND NONEQUILIBRIUM LAMINAR BOUNDARY LAYERS INDUCED BY A NORMAL SHOCK WAVE IN AN IONIZED ARGON**
W. S. Liu Oct. 1975 101 p refs Sponsored by NRC
(Grant AF-AFOSR-2274-72C)
(UTIAS-198; CN-ISSN-0082-5255) Avail: NTIS HC $5.50
The structure of a strong normal shock wave moving into argon and the nonequilibrium flow of partially ionized argon in the laminar boundary layers induced behind the shock wave on the shock-tube walls and over a flat plate are described. The subsequent interaction of the laminar boundary layer with a corner-expansion flow was also considered. An integral method was used in the analysis to study both the shock induced nonstationary laminar boundary layer on the shock-tube walls and the quasi-steady flat-plate laminar boundary layer for an ionized argon flow. The frozen, equilibrium and nonequilibrium flow solutions were obtained and compared with some existing experimental results. The calculated results based on the integral method were found to be in agreement with the experimental data for the shock-induced wall boundary layer, but they did not agree with the experimental data for the flat-plate quasi-steady boundary layer. The cold-wall similarity method of Sullivan was extended to apply to the interaction of a laminar boundary layer with a corner-expansion wave for a supersonic frozen flow. The validity of the extended method is discussed.
Author

**N76-16374#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**NUMERICAL MODELLING OF TURBULENT TRANSPORT PROCESSES IN THE MIXING ZONE**
A. F. Kurbatskii 1975 10 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 3, 1975 p 125-133
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616
A number of moments of the velocity field in a two-dimensional turbulent mixing zone is calculated by a numerical solution of the system of turbulent transport equations derived from the equations for a single-point distribution function of the velocity pulsation field, and simplified in the boundary layer approximation. The closed form of the transport equations is obtained at the third moment level by using Millionshchikov hypotheses. In such a closure the system differential operator turns out to be slightly hyperbolic and not parabolic. A difference scheme realized by the factorization method is proposed. Author

**N76-16375*#** Michigan State Univ., East Lansing. Div. of Engineering Research.
**THE OBLIQUE IMPINGEMENT OF AN AXISYMMETRIC JET Annual Report**
John F. Foss and Stanley J. Kleis 9 Feb. 1976 185 p refs
(Grant NGR-23-004-068)
(NASA-CR-134961; AR-2) Avail: NTIS HC $7.50 CSCL 20D
The mechanics of the oblique impingement of an axisymmetric jet on a plane surface are examined in detail. The stagnation point is discussed. A schematic drawing of the problem and coordinate system used to describe the flow field are given. The kinematic features of the flow above the plate are examined in the context of the conservation of mass, the vorticity of the jet, and the vorticity introduced by the jetplate interaction. The dynamic features of the flow are examined in terms of the surface pressure distribution and the cause-effect relationships which exist between the pressure and velocity/vorticity distributions. Flow calculations performed are given. The investigation is relevant to the flow resulting from the interaction of the propulsion jet with the main airfoil (STOL aircraft), and is appropriate to an over- or under- wing configuration.
Author

**N76-16376*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.
**AN OPTICAL METHOD FOR THE STUDY OF THE DISTRIBUTION OF DIFFUSING GAS CONCENTRATIONS ALONG A CAPILLARY**
V. F. Vyshenskaya, N. D. Kosov, L. I. Kurlanov, and G. N. Martynova Washington Dec. 1975 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kaz. SSR, Ser. Fiziol.-Mat. (USSR), v. 11, no. 2, 1973 p 38-42
(Contract NASw-2789)
(NASA-TT-F-16676) Avail: NTIS HC $3.50 CSCL 20D
An optical method is described which measures a stationary distribution of concentrating diffusing gases along a capillary in various systems, and results of measuring the carbon dioxide and Freon-12 for a binary system are presented. A stationary distribution of the concentration in a diffusion capillary was established by a method presented earlier to measure true and mutual coefficients of diffusion.
Author

**N76-16377*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.
**STUDY OF HEAT TRANSFER TO NITROGEN LIQUID VAPOR STREAMS DURING DISCHARGE INTO A SMALL CHAMBER**
V. P. Belyakov, V. V. Budrik, and V. A. Shaposhnikov Washington NASA Dec. 1975 13 p Transl. into ENGLISH of rept. from Russian conf. Presented at Intern. Congr. on Refrig., Moscow, 22-30 Sep. 1975 13 p
(Contract NASw-2481)
(NASA-TT-F-16837) Avail: NTIS HC $3.50 CSCL 20D
The investigation performed on foamy boiling shows that during such boiling, both the thickness of the vapor boundary film and the stream velocity affect the heat transfer process. For all cases of heat transfer during discharge into a small chamber, including bubbling and foam boiling, the exponent is identical and coincides as during the flow of a single-stage stream. This circumstance indicates the similarity in the formation of a boundary layer in the single-stage stream and specific boundary layers of two-stage streams with the widest range of velocity changes and vapor contents.
Author

**N76-16378*#** Scientific Translation Service, Santa Barbara, Calif.
**THEORY OF PERTURBATIONS OF STATIONARY FLOW OF A VISCOUS INCOMPRESSIBLE FLUID AT LOW REYNOLDS NUMBERS**
K. I. Babenko Washington NASA Feb. 1976 58 p refs Transl. into ENGLISH from Inst. of Appl. Math., Acad. Sci. USSR (Moscow), Preprint no. 79, 1975 p 1-71
(Contract NASw-2791)
(NASA-TT-F-16832) Avail: NTIS HC $4.50 CSCL 20D
The uniqueness of the solution to the problem of the flow past a body at small Reynoids numbers was investigated in detail. A criterion was established for the failure of uniqueness. The theory of perturbations of the solution is constructed when the Reynolds number is not small. A formula is given for the force which acts on the body; Stokes' formula and other formulas were established which were obtained by the method of joining together asymptotic expansions. In this way, in the problems under consideration, the method of combined asymptotic expansions is substantiated.
Author

**N76-16379*#** TRW Systems Group, Redondo Beach, Calif. Materials Technology Dept.
**VAPOR-MODULATED HEAT PIPE REPORT. FLIGHT DATA ANALYSIS AND FURTHER DEVELOPMENT OF VARIABLE-CONDUCTANCE HEAT PIPES**
James E. Eninger, George L. Fleischman, and Edward E. Luedke

30 Jun. 1975 65 p refs
(Contract NAS2-8310)
(NASA-CR-146143; TRW-26263-6015-RU-00) Avail: NTIS HC $4.50 CSCL 20M

The design and testing of a heat pipe for spacecraft application is presented. The application in mind calls for heat loads up to 20 watts, a set-point temperature of 294K, and a sink that varies from -220K to nearly as high as the set-point. The overall heat pipe length is 137 cm. Two basically different mechanisms of achieving variable conductance in the pipe by vapor-flow throttling were studied. In one, the thermal resistance between the heat source and sink is due to a saturation-temperature drop corresponding to the vapor-pressure drop developed across the valve. In the other, the pressure difference across the valve induces capillary groove and wick dry out in an evaporation region, and thus results in an increased thermal resistance. This mechanism was selected for fabrication and testing. The pipe is a stainless-steel/methanol two-heat-pipe system. Results are presented and discussed. Engineering drawings and specifications of the pipe are shown. Author

**N76-16380#** Hamburg Univ. (West Germany). Inst. fuer Schiffbau.
**PRESSURE FIELDS AT HYDROFOILS AND PROPELLERS IN GAS CONTAINING WATER [DRUCKFELDER VON TRAGFLUEGELN UND PROPELLERN IN GASHALTIGEM WASSER]**
W. H. Isay, T. Roestel, and R. Koops Bonn DOKZENTBw 1975 34 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(BMVG-FBWT-75-3) Avail: NTIS HC $4.00; DOKZENTBw DM 20

Compressible flow of gas-containing water around hydrofoils and propeller foils was studied. Methods to solve the hydrodynamic equations, by transformation into nonlinear integral equations, are detailed. The most important results are interpreted and the cavitation properties of propeller wings and hydrofoils are discussed. Finally the dynamics of cavitation bubbles is dealt with. ESA

**N76-16381#** Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
**ON VELOCITY PROFILE MEASUREMENTS IN MICROCHANNELS USING THE LASER ANEMOMETER [ZUR MESSUNG VON GESCHWINDIGKEITSPROFILEN IN MIKRO-KANAELEN MIT DEM LASER-ANEMOMETER]**
W. J. Hiller and A. Z. Smolarski Feb. 1975 16 p refs In GERMAN
(Rept-1/1975) Avail: NTIS HC $3.50; Max-Planck-Inst. fuer Stroemungsforsch., Goettingen, West Ger. DM 3

The application of laser anemometry to velocity measurement in microchannels, particularly in the case when particles are suspended in the flow medium, is discussed. The principle of the technique is dealt with and the measuring procedure is detailed. The measuring results are discussed and the limitations of the procedure are indicated. ESA

**N76-16382#** Bristol Univ. (England). Dept. of Aeronautical Engineering.
**AN INVESTIGATION OF DYNAMIC AQUAPLANING USING SMALL PNEUMATIC TIRES Ph.D. Thesis**
Roger IAnson Aug. 1973 342 p refs Sponsored by Min. of Technol.
Avail: NTIS HC $10.00

The dynamic aquaplaning of pneumatic tires with diameters ranging from 9 to 17 inches, was investigated on a rolling road test apparatus using a 1/4 in. deep water layer laid onto the ground belt at matching speed. The aquaplaning speed was found to be related to the average ground contact pressure, higher contact pressures giving higher aquaplaning speeds. The tire inflation pressure was the main component of the ground contact pressure but there were contributions from the tire causing stiffness and centrifugal effects due to tire rotation. Further investigations include tin shapes during aquaplaning, water pressures, flow analysis, and longitudinal tread grooving. ESA

**N76-16383#** Pacific Northwest Environmental Research Lab., Corvallis, Ore.
**ANALYSIS OF MULTIPLE CELL MECHANICAL DRAFT COOLING TOWERS Ecological Research Series.**
Lorin R. Davis May 1975 24 p refs
(PB-244807/4; EPA-660/3-75-039) Avail: NTIS HC $3.50 CSCL 20D

This report presents the development of a mathematical model designed to calculate the rise and dilution of plumes from multiple cell mechanical draft cooling towers. The model uses integral methods and includes the initial development zone, the individual single plumes zone, and the zone of merging multiple plumes. Although the governing equations for moist plumes are presented, the final working equations are for dry plumes only. Techniques were used that allow for a gradual merging of plumes without a discontinuity in the calculation of plume properties. Entrainment techniques that include the interference of unmerged plumes and the reduction of entrainment surfaces after merging are presented. The entrainment expression includes coefficients that need to be determined by tuning the model with experimental data. GRA

**N76-16384#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**PERFORMANCE CHARACTERISTICS OF EJECTOR DEVICES Final Report, Apr. 1973 - Jan. 1975**
Siegfried H. Hasinger Jun. 1975 120 p refs
(AF Proj. 7116)
(AD-A015040; ARL-75-0205) Avail: NTIS CSCL 19/5

A comprehensive performance analysis of ejector devices, which accounts for compressibility, heterogeneous operating media, and incidental flow losses under the simplifying assumptions of one-dimensional flow conditions and complete mixing at the end of the mixing section, leads to quite lengthy relations, which in part can be solved only by iteration. This report aims at arranging these relations in a way that they can be readily handled on a programmable desk calculator. The purpose is to study ejector devices on a basis as general as possible without sacrifice in accuracy. Various mixing modes, at constant area, at constant pressure, and at a defined pressure distribution are studied. An investigation of the optimum ejector reveals that an essential factor for the lay-out is the choice of the inlet Mach number ratio of the operating media. For constant area mixing the optimum ratio falls within a range, where the mixing mode has little influence on the performance. Thus the performance of constant pressure mixing, which is in general superior to that of constant area mixing, can be approached by constant area mixing if the inlet Mach number ratio is optimized. This is very important for supersonic ejectors since they do not allow the realization of constant pressure mixing due to the inherent presence of supersonic shocks during mixing. Author (GRA)

**N76-16385#** Naval Coastal Systems Lab., Panama City, Fla.
**PROGRAMS FOR THE CALCULATION OF PRESSURE DISTRIBUTION AND BOUNDARY LAYER ABOUT AN AXISYMMETRIC BODY Final Report**
Ray R. Mallory Dec. 1974 43 p refs
(SF34371702)
(AD-A003466; NCSL-222-74) Avail: NTIS CSCL 20/4

The detailed pressure distribution, velocity, and boundary layer properties of an axisymmetric body in a fluid flow are useful information for the proper treatment of hydrodynamic design for such bodies. Use of the Douglas Potential Flow Program and the Douglas Boundary Layer Program have been shown to be accepted methods by which this information can be obtained. The two programs, their input and output, and some of the ways data obtained may be applied to practical problems are described. A way of accounting for the viscous effect on the pressure distribution about a body caused by the boundary layer is given. The method is applied to a typical body and results are compared with experimental data. GRA

**N76-16386#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
**THREE DIMENSIONAL HEAT AND MASS TRANSFER EFFECTS ACROSS HIGH SPEED REATTACHING FLOWS Interim Scientific Report**
G. R. Inger Jul. 1975 41 p refs
(Grant AF-AFOSR-2173-72; AF Proj. 9781)
(AD-A015390; VPI-AERO-036; AFOSR-75-1386TR) Avail:

NTIS CSCL 20/4

The three dimensional heat transfer perturbations occurring in nominally two-dimensional reattaching flows is studied theoretically using a vortex-disturbance model. The surface material response aspect is included. The results are found to be in good agreement with experiment. GRA

**N76-16387#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.

**VISCOUS FLOW INTERACTION STUDIES Final Report, 1 Jul. 1965 - 30 Jun. 1974**

Robert H. Korkegi Jul. 1975 55 p refs

(AF Proj. 7064)

(AD-A015191; ARL-0164) Avail: NTIS CSCL 20/4

The research was designed to gain understanding of the flow of air at high speeds over the components of lifting supersonic and hypersonic vehicles--wings, flaps, fins, inlets--and their interactions with respect to heating, surface friction, pressure, and aerodynamic forces. The objective was to help predict (a) flows on complex aerospace vehicle configurations in high-speed flight and (b) the location of areas of high heating. The research covers the areas of laminar and turbulent boundary layers, boundary layer transition, boundary layer separation, base flows and wakes, low density flows, three-dimensional interactions, viscous flow problems, and some flow measurement techniques. GRA

**N76-16388#** Pennsylvania State Univ., University Park.

**WATER TUNNEL SIMULATION STUDY OF THE LATER STAGES OF WATER ENTRY OF CONICAL HEAD BODIES**

J. H. Kim and J. W. Holl Jun. 1975 71 p refs

(Contract N00017-73-C-1418)

(AD-A015129; TM-75-177) Avail: NTIS CSCL 20/4

The feasibility of utilizing a water tunnel for studying the cavity-running phase of water entry was explored in this test program. Using conical head models, steady state ventilated cavity tests were conducted in the 12-inch water tunnel to determine cavitation number versus cavity length, pressure distribution, ventilation air flow coefficient and cavity area coefficient. Following these steady-state tests, a cavity attrition test was performed to simulate the decay of the cavity in the last stage of water entry prior to fully wetted flow. The results are interpreted as an indication that quasi-steady analysis may be useful for studying water entry phenomenon at least for decelerations of the order of 3 ft/sec/sec. GRA

**N76-16389#** Michigan Univ., Ann Arbor.

**BOUNDARY LAYERS WITH LARGE LOCAL GRADIENTS Final Report, 1 Jul. 1968 - 30 Jun. 1975**

A. F. Messiter 14 Aug. 1975 12 p refs

(Contract DAHC04-68-C-0033)

(AD-A015574; ARO-7324.6-E) Avail: NTIS CSCL 20/4

A number of problems involving laminar boundary-layer interaction with an external flow are studied with the use of matched inner and outer asymptotic expansions. Among the examples included are incompressible boundary-layer flow at the trailing edge of a flat plate, interaction of a boundary layer and a weak incident oblique shock wave at supersonic and transonic speeds, base flow behind a wedge or backward-facing step at supersonic speeds, separation of an incompressible boundary layer, and leading and trailing-edge flows for a heated vertical plate in free convection. GRA

## 35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

**N76-16390*** National Aeronautics and Space Administration. Pasadena Office, Calif.

**MAGNETOMETER USING SUPERCONDUCTING ROTATING BODY Patent**

Melvin M. Saffren (JPL) and Daniel D. Elleman, inventors (to NASA) (JPL) Issued 2 Dec. 1975 8 p Filed 11 Nov. 1974 Supersedes N75-11309 (13 - 02, p 0171) Sponsored by NASA

(NASA-Case-NPO-13388-1; US-Patent-3,924,176; US-Patent-Appl-SN-522552; US-Patent-Class-324-43R) Avail: US Patent Office CSCL 14B

A method and apparatus for measuring the strength and direction of an unknown magnetic field are disclosed. A freely rotatable suspended superconducting body, such as a sphere, is maintained at a superconducting temperature. A magnetic field to be measured induces super current flow on the sphere's surface. The induced current causes the sphere to rotate at a rate that is proportional to the strength of the field, and the axis of rotation of the sphere aligns with the direction of the magnetic field to be measured. An operator applies current to orthogonal electromagnetic coils arranged relative to the sphere so as to apply variable magnetic fields to the sphere. Varying the current and the resulting fields nulls out the effect of the magnetic field to be measured; measurement of the nulling currents indicate the direction and strength of the unknown magnetic field.

Official Gazette of the U.S. Patent Office

**N76-16391*** National Aeronautics and Space Administration. Pasadena Office, Calif.

**SCAN CONVERTING VIDEO TAPE RECORDER Patent**

Norman I. Holt, inventor (to NASA) (JPL) Issued 2 Dec. 1975 9 p Filed 27 Oct. 1971 Continuation-in-part of abandoned US Patent Appl. SN-668116, filed 15 Sep. 1967 Sponsored by NASA

(NASA-Case-NPO-10166-2; US-Patent-3,924,267; US-Patent-Appl-SN-192803; US-Patent-Class-360-9; US-Patent-Class-360-10; US-Patent-Class-360-35; US-Patent-Class-360-101; US-Patent-Appl-SN-668116) Avail: US Patent Office CSCL 14B

A video tape recorder with broad bandwidth capabilities for recording color television signals, and which has the capability of playing back the recorded television signals at a scan rate different from that at which the signals were recorded is introduced. The recorder also allows television signals of one scanning standard to be converted to television signals of a second scanning standard.

Official Gazette of the U.S. Patent Office

**N76-16392*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**CLOCK SETTER Patent**

Claude T. Haley, inventor (to NASA) Issued 30 Dec. 1975 4 p Filed 9 Sep. 1974 Supersedes N74-32882 (12 - 22, p 2694)

(NASA-Case-LAR-11458-1; US-Patent-3,929,364; US-Patent-Appl-SN-504225; US-Patent-Class-294-19R; US-Patent-Class-294-1R) Avail: US Patent Office CSCL 14B

An apparatus is described for manually adjusting large wall-mounted clocks while the operator remains safely on the floor, comprising a long handled tool which slips over the reset knob of such clocks allowing a downward and twisting motion to adjust the indicated time.

The Official Gazette of the U.S. Patent Office

**N76-16393*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**MOVING PARTICLE COMPOSITION ANALYZER Patent**

Siegfried O. Auer, inventor (to NASA) (NAS-NRC) Issued 6 Jan. 1976 6 p Filed 30 Aug. 1974 Supersedes N74-32887 (12 - 22, p 2694) Sponsored by NASA

(NASA-Case-GSC-11889-1; US-Patent-3,931,516; US-Patent-Appl-SN-502124; US-Patent-Class-250-281; US-Patent-Class-250-287; US-Patent-Class-250-288; US-Patent-Class-250-385; US-Patent-Class-250-423) Avail: US Patent Office CSCL 14B

A mass spectrometry apparatus for analyzing the composition of moving microscopic particles is introduced. The apparatus includes a capacitor with a front electrode upon which the particles impinge, a back electrode, and a solid dielectric sandwiched between the front and back electrodes. In one embodiment, the

electrodes and dielectric are arcuately shaped as concentric peripheral segments of different spheres having a common center and different radii. The front electrode and dielectric together have a thickness such that an impinging particle can penetrate them. In a second embodiment, the capacitor has planar, parallel electrodes, in which case the ejected positive ions are deflected downstream of a planar grid by a pair of spaced, arcuate capacitor plates having a region between them through which the ejected ions travel. Official Gazette of the U.S. Patent Office

**N76-16394** Johns Hopkins Univ., Baltimore, Md.
**LOW ENERGY ELECTRON IMPACT SPECTROSCOPY OF ORGANIC MOLECULES: DEVELOPMENT OF A CROSSED-BEAM ELECTRON SPECTROMETER Ph.D. Thesis**
Willard M. St.John, III 1975 185 p
Avail: Univ. Microfilms Order No. 76-1506

A new low-energy high resolution electron impact spectrometer for the study of organic molecules was constructed. The incident electron beam in the collision region has a current of two to ten nanoamperes with energy full-width-at-half-maximum of 65 to 100 meV over an incident energy range of ten to one hundred electron volts. The scattered electron beam may be measured over an angular range of - 20 deg to + 135 deg with a resolution of one degree. An electron multiplier detector circuit makes possible the detection of intensities of a few electrons per second. An investigation of the acetone molecule is presented. The more important results of the study are confirmation of the singlet manifold transition energies, confirmation of the location in energy of the first triplet state and a direct observation of the second triplet state. Analysis of the energy and angular dependence of the transition intensities provides information useful in assigning the symmetry properties of the transitions. Dissert. Abstr.

**N76-16395*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**METHOD AND APPARATUS FOR CONTROLLING THE CONTRAST OF A PHOTOGRAPHIC TRANSPARENCY Patent Application**
Sing H. Lee and Arnold R. Shulman, inventors (to NASA) Filed 30 Dec. 1975 19 p
(NASA-Case-GSC-11989-1; US-Patent-Appl-SN-645500) Avail: NTIS HC $3.50 CSCL 14E

An apparatus and method for controlling the contrast of a photographic transparent image by projecting a coherent beam of optical energy onto the image via an optical cavity are reported. Mirrors are used to trap a collimated laser beam illuminating the transparency so that at least a portion of the beam energy is passed through the transparency plural times. The distance that the light beam travels-between the mirrors is controlled as a function of the wavelength of the beam energy to control the phase of light interference in the beam passing through the transparency, thereby controlling the intensity of the beam derived from the mirror downstream of the transparency. The contrast of the transparency is increased or decreased, depending upon whether constructive or destructive interference for the beam energy is provided by the mirror spacing. For a negative input transparency a low to high contrast projected negative or positive image can be obtained. NASA

**N76-16396*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**MINIATURE BIAXIAL STRAIN TRANSDUCER Patent Application**
Ira S. Hoffman, inventor (to NASA) Filed 30 Dec. 1975 13 p
(NASA-Case-LAR-11648; US-Patent-Appl-SN-645571) Avail: NTIS HC $3.50 CSCL 14B

A reusable miniature strain transducer is described for use in the measurement of static or quasi-static, high level, biaxial strain on the surface of test specimens or structures. Two cantilever arms, constructed by machining the material to appropriate flexibility, are self-aligning and constitute the transducing elements of the device. Used in conjunction with strain gages, the device enables testing beyond normal gage limits for high strains and number of load cycles. The device does not require conversion computations since the electrical output of the strain gages is directly proportional to the strain measured. NASA

**N76-16397*#** Scientific Translation Service, Santa Barbara, Calif.
**TEMPERATURE PROBES FOR FLOWS AT HIGH ENTHALPY**
D. Gautrot Washington NASA Jan. 1976 18 p refs Transl. into ENGLISH from Mesures (France), no. 3, Mar. 1972 p 95-99
(Contract NASw-2791)
(NASA-TT-F-16833) Avail: NTIS HC $3.50 CSCL 14B

Two types of probes are described for determining the distribution of the thermal field, and for measurement of the local cutoff temperatures in order to define a temperature gradient in a given direction. The probes are of the pulsed type and the sonic double throat type. The first probe measures the cutoff pressure of the flow; it consists of a chromel-alumel thermocouple separated with the aid of an aluminum bead. Nitrogen is pulsed in a central tube under a pressure double that of the cutoff pressure at the right of the probe. Good thermal behavior was noted. The second probe consists of two sonic throats in series. The cutoff pressure is measured at the first throat, and the cutoff temperature at the second throat. The sonic double throat probe gives results slightly better than the pulsed probe. Author

**N76-16398#** Institut Franco-Allemand de Recherches, St. Louis (France).
**USE OF A SLIT CAMERA FOR OBTAINING INTEGRAL IMAGES OF VERY RAPID PHENOMENA [UTILISATION D'UNE CAMERA A FENTE EN VUE D'OBTENIR DES IMAGES INTEGRALES DE PHENOMENES ULTRA-RAPIDES]**
Y. DeLongueville 13 Mar. 1975 15 p ref In FRENCH
(ISL-R-106/75) Avail: NTIS HC $3.50

A method allowing the obtainment of successive shadowgraph images of a very short-lived phenomenon with a simple slit camera is described. It consists in originating by explosion high frequency (about 1 MHz) short light pulses (10 nsec) in a succession of very thin argon compartments, as used in shadowgraphy. The method is applied to integral photography of the jet of a shaped charge emerging from confinement. Author (ESA)

**N76-16399#** Lund Univ. (Sweden). Dept. of Physics.
**EXPERIMENTAL AND THEORETICAL ABSORPTANCE PROFILES OF TRACKS OF FAST HEAVY IONS IN NUCLEAR EMULSION**
M. Jensen, L. Larsson, O. Mathiesen, and R. Rosander Aug. 1974 48 p refs
(LUIP-CR-74-07) Avail: NTIS HC $4.00

Transverse absorptance profiles of 27 tracks of cosmic ray nuclei recorded in Ilford G5 nuclear emulsion were measured by a nuclear track photometer. Included in the study were nuclei with atomic numbers 14, 16, 20, 24, and 26 with velocities relative to that of light within the interval beta between 0.3 and 0.8. The experimental absorptance profiles were compared with theoretical profiles calculated from the delta-ray theory of track formation developed by Katz and co-workers. Taking into account the re-scattering of light into the cone of acceptance of the photometer, good agreement has been found between experimental and theoretical profiles within the entire charge and velocity interval. The semi-empirical formula for high aperture photometry is discussed in some detail, as well as the theory of delta-ray production and the transport of electrons and their energy dissipation in nuclear emulsion. Author (ESA)

**N76-16400#** Lund Univ. (Sweden). Dept. of Physics.
**MEASURED AND CALCULATED ABSORPTANCE OF TRACKS OF FAST HEAVY IONS IN ILFORD G5 NUCLEAR EMULSION**
M. Jensen and O. Mathiesen Apr. 1975 34 p refs
(LUIP-CR-75-03) Avail: NTIS HC $4.00

A modified form of the delta-ray theory of track formation developed by Katz and co-workers was used to calculate the absorptance of tracks of fast heavy ions in Ilford G5 nuclear emulsion. The theoretical data was compared with results of different photometrical investigations reported in the literature. In most cases the theoretical predictions are found to be in good agreement with experiments. This suggests that the theory can be used in the planning and execution of future experiments, i.e. to optimize the geometry of the photometer and to obtain

an absolute charge calibration of the detector. It is shown that the basic photometrical properties of an emulsion stack can be described by a single quantity which can be determined from measurements. Knowing this quantity it is possible to predict the response of the emulsion stack for different types of photometers. The practical limits of the use of the modified theory at high and low levels of energy dose are discussed.
Author (ESA)

**N76-16401#** European Space Agency, Paris (France).
**APPLICATION OF COHERENT ANTI-STOKES RAMAN SCATTERING TO THE MEASUREMENT OF GAS CONCENTRATIONS AND TO FLOW VISUALIZATION**
Pierre Regnier Nov. 1975 47 p refs Transl. into ENGLISH of "Appl. de la Diffusion Anti-Stokes Coherente a la Mesure de Concentrations Gazeuses et a la Visualisation des Ecoulements", ONERA, Paris Report ONERA-NT-215, 1973
(ESA-TT-200; ONERA-NT-215) Avail: NTIS HC $4.00

A new method of gas concentration measurement is described. This method is based on parametric four wave mixing: two colinear beams of frequencies f sub 1 and f sub 2 give rise to a colinear wave (anti-Stokes) at frequency 2f sub 1-f sub 2 when passing through a gas containing Raman active molecules whose vibration frequency is f sub v=f sub 1-f sub 2. The intensity of the wave created is proportional to the square of the number of resonant molecules. This scattering is much more intense than the spontaneous Raman scattering. Some results were obtained with hydrogen; the hydrogen concentration of a gas flame was mapped and small jets in the atmosphere were photographed in anti-Stokes light. The limitations of the method and its field of application are discussed. Author (ESA)

**N76-16402#** European Space Agency, Paris (France).
**HIGH-RESOLUTION INFRARED SPECTROMETRY AROUND 27 MICROMETERS: APPLICATION TO METHYL CYANIDE**
Renee Giraudet Nov. 1975 65 p refs Transl. into ENGLISH of "Spectrometrie Infrarouge a Haute Resolution vers 27 Micrometres; Appl. au Cyanure de Methyle", ONERA, Paris Report ONERA-NT-217, 1974
(ESA-TT-201; ONERA-NT-217) Avail: NTIS HC $4.50

Spectra of methyl cyanide in gaseous state were recorded around 27 micron with a grid spectrometer equipped with an accurate wave number calibration device. The instrument resolution at this wavelength is sufficient to reveal a line structure; this was analyzed by means of the calculation of a synthetic spectrum, as the theory of the methyl cyanide molecule, which is part of the C3v symmetry group, is known. The anomalous aspect of the spectrum was thus explained by the very particular values of molecular constants and by the presence of hot bands. Author (ESA)

**N76-16403#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INTEREST IN SENSORS QUALIFIED IN SITU AS REGARDS MEASUREMENT ACQUISITION**
M. Chatanier 21 May 1975 14 p refs Transl. into ENGLISH from the book "Colloque sur L'Automatisation des Techniques et des Methodes de Mesure Toulouse" France, TP no. 1331, 4-8 Mar. 1974 p 1-5
(AD-A014519; FTD-ID(RS)I-1412-75) Avail: NTIS CSCL 14/2

The National Center for Aerospace Study and Research (ONERA) is studying a new generation of sensors with digital output which have the special feature of realizing the quantification of the measurement at the very level of the sensitive element, without needing an analogue-digital converter. This principle uses the properties of a thin magnetostrictive and anisotropic layer.
GRA

**N76-16404#** National Oceanographic Instrumentation Center, Washington, D.C.
**UNIVERSAL GRAPHIC RECORDER MODEL UGR-196C**
Aug. 1975 13 p Prepared in cooperation with Raytheon Co., Portsmouth, R. I.
(COM-75-11215/1; Instrument-Fact-Sheet-76003; NOAA-75082101) Avail: NTIS CSCL 14C

A few of the possible applications of the UGR are to record echo soundings, seismic profiles, facsimile copies, spectral data, and to display computer generated data. The recording medium is dry electrosensitive paper. The paper roll size is 19 1/8 in. by 120 ft. with a usable scan width of 18.85 in. The viewing area is the full chart width by 12-in. long including the first printed line. Grid lines are switch selectable: 10 or 20 divisions across the chart. Line densities of 160, 128, 80, 64, and 40 lines per in. also can be selected by a switch setting. The scan mechanism is a belt with three equally spaced styluses driven by a synchronous motor. The sweep drive is generated internally by a 38.4-kHz oscillator, which makes the motor drive frequency nearly independent of power line variation. A motor frequency reference can also be supplied from an external source.
GRA

**N76-16405#** Washington Univ., Seattle. Div. of Marine Resources.
**AN OPERATOR'S MANUAL FOR THE HYDROACOUSTIC DATA COLLECTION SYSTEM**
Edmund P. Nunnalle Feb. 1975 33 p
(Grant NOAA-04-3-158-42)
(COM-75-11341/5; WSG-TA-75-1; NOAA-75090203) Avail. NTIS HC $4.00 CSCL 14B

A description of the parts of the various pieces of equipment in the system is included along with photographs indicating the locations of connectors and controls. The interconnections of the various system components are outlined. System setup, calibration, and operation during a hydroacoustic survey are described. The major components of the hydroacoustic data collection system include a Ross model 200 A echo-sounder chart recorder, an interface amplifier, a Sony model 560D magnetic tape recorder, a Teredo ac to dc power inverter, a variac (variable transformer) and an oscilloscope.
GRA

**N76-16406#** National Bureau of Standards, Washington, D.C. Center for Fire Research.
**RESULTS OF FULL-SCALE FIRE TESTS WITH PHOTOELECTRIC SMOKE DETECTORS Final Report**
Richard W. Bukowski and Richard G. Bright Jun. 1975 57 p refs
(COM-75-11280/5; NBSIR-75-700) Avail: NTIS HC $4.50 CSCL 14B

In February 1974, a series of full-scale fire tests were conducted to determine whether photoelectric-type smoke detectors could respond to the same types of fires used to assess the performance of ionization-type smoke detectors. In addition to the UL-167 standard fires, fires involving polyurethane (flaming mode) and cotton (smoldering mode) were added to the test series. One detector, utilizing a Taguchi gas sensor (TGS), was included in the test series for evaluation purposes. The test results indicated that the better photoelectric smoke detectors detect the same test fires as the ionization chamber smoke detectors in approximately the same time scale. For the smoldering cotton fire, the photoelectric detectors were significantly faster than the ionization chamber detectors. The TGS fire detector was unable to detect most of the test fires.
GRA

**N76-16407#** National Bureau of Standards, Washington, D.C. Inst. for Applied Technology.
**POLYMERIC PYROELECTRIC SENSORS FOR FIRE PROTECTION Final Report, Jun. 1972 - May 1973**
Julius Cohen and Seymour Edelman Jul. 1975 34 p refs
(AF Proj. 3048)
(AD-A014830; NBSIR-75-728; AFAPL-TR-74-16) Avail: NTIS CSCL 17/5

This report summarizes the results of a program to develop optical radiation sensors for fire detection using polymeric pyroelectric sensing elements. Emphasis has been placed on techniques for constructing such devices, including methods of enhancing the pyroelectric response. Materials investigated included polyvinyl fluoride (PVF) and polyvinylidene fluoride (PVF2). Six sensors were developed and delivered to the sponsor. Highlights reported include achievement of a value of specific detectivity, D 2 x 10 to the 8th power cm. square root of Hz.1/w and the construction of a set of sensors useful over a wavelength range extending from the ultraviolet to the infrared. Methods of characterizing the performance of sensor elements are described. Author (GRA)

**N76-16408#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**RESEARCH ON HIGHLY SENSITIVE INFRARED DETECTORS FOR IMPROVED RECONNAISSANCE Final Technical Report, 1 Jul. 1964 - 30 Jun. 1972**
Radames K. H. Gebel, James H. Gorrell, and Roy R. Hayslett Jun. 1975 39 p refs
(AF Proj. 7885)
(AD-A014743; ARL-75-0207) Avail: NTIS CSCL 17/5

This report presents some of the research efforts which lead to new concepts for opto-electronic imaging arrangements. This endeavor was ultimately concerned with the detection of dynamic events where the images are formed by radiation with a quantum energy insufficient for the external photoeffect. A vacuum image converter tube for the latter was conceived and built which by means of a semiconductive coating on a mesh screen and by appropriate electron flooding of this mesh in several steps, produces a simultaneous visible image on a phosphor screen. Controllable contrast enhancement is also possible by proper selection of the electrode voltages. The above endeavors were preceeded by theoretical investigations concerned with the threshold limit in photodetection by considering the quantum nature of light and consequently the statistical behavior of the conversion of radiant energy into electrical carriers, etc. Other problems related to photodetection and visual perception were investigated. GRA

**N76-16409#** National Oceanographic Instrumentation Center, Washington, D.C.
**INSTRUMENT FACT SHEET: CTS/SV OCEANOGRAPHIC DATA ACQUISITION SYSTEM MODEL 3200-3004-170**
Aug. 1975 17 p refs
(COM-75-11339/9; IFS-76002) Avail: NTIS HC $3.50 CSCL 08J

The system is designed to obtain continuous vertical or horizontal (tow) measurements of electrical conductivity, temperature, sound velocity and pressure in the ocean. The underwater unit consists of two pressure cases, one housing the sound velocity and depth transducers, and the other containing the conductivity and temperature transducers, each with signal conditioning circuits for transmission of data to the shipboard signal converter. Temperature is sensed with a platinum-resistance thermometer, conductivity with an inductively coupled torroidal cell, sound velocity with a transducer using a sing-around circuit, and pressure with a resistance straingage bridge. Power is supplied to the underwater unit by a shipboard power supply operating at a constant current (550 mA). GRA

**N76-16410#** National Oceanographic Instrumentation Center, Washington, D.C.
**INSTRUMENT FACT SHEET: ACOUSTIC RELOCATION SYSTEM, MODEL 301 AND RECOVERABLE ACOUSTIC TRANSPONDER, MODEL 322 Instrument Fact Sheet 76001**
Aug. 1975 21 p
(COM-75-11340/7) Avail: NTIS HC $3.50 CSCL 08J

The Model 301 acoustic relocation system and model 322 recoverable acoustic transponder are designed to provide an acoustic link for marking, locating, and recovering instrument packages or other items from the sea floor. The 301 system consists of a coder and a power amplifier (both Model 200) and a receiver and a transducer (both Model 301). The basic command signal is a five- 'level' pulse train coded as follows: (1) carrier frequency, (2) modulation frequency, (3) pulse width, (4) pulse repetition frequency, and (5) time duration. These parameters are varied to produce three different codes for the inhibit, confirmation reply/enable, and release commands. GRA

**N76-16411#** National Bureau of Standards, Washington, D.C. Electricity Div.
**CALIBRATION OF KERR SYSTEMS USED TO MEASURE HIGH VOLTAGE PULSES Final Report, Jul. 1974 - Jun. 1975**
Robert E. Hebner, Jr. Aug. 1975 52 p refs Sponsored by Sandia Corp., Albuquerque
(COM-75-11364/7; NBSIR-75-774) Avail: NTIS HC $4.50 CSCL 14B

The purpose of this work was to define, develop and refine techniques for calibrating pulse voltage measurement systems, particularly those based on the electro-optic Kerr effect. The approach used exploits the assumed frequency independence on the Kerr coefficient of nitrobenzene. The report describes the present best comparison of cell calibration under direct voltage with calibration under low frequency alternating voltage and calibration under pulsed high voltage. The results under all three types of waveforms agree to within plus or minus 0.5 percent. From these results it can be inferred that it is feasible to use an electro-optic Kerr system as an independent, and possibly more accurate, device against which to calibrate other pulse voltage measurement systems. GRA

**N76-16412#** Holosonics, Inc., Richland, Wash.
**SCANNED ACOUSTICAL HOLOGRAPHY FOR GEOLOGICAL PREDICTION IN ADVANCE OF RAPID UNDERGROUND EXCAVATION, PHASE 1**
T. O. Price, B. B. Brenden, H. D. Collins, and J. Spalek 30 May 1975 115 p refs
(Grant NSF GI-43686)
(PB-245147/4; NSF/RA/T-75/024) Avail: NTIS HC $5.50 CSCL 13B

A high priority for improving productivity is the development of geological techniques for determining rock and groundwater conditions prior to excavation. This program was to demonstrate the use of acoustical holography methods to detect and image targets in a volume of rock, and to show how the existing system of rectilinear scanned holography could be so modified to be most efficient and most compatible for 'real-time' use in a tunnel with a tunnel boring machine. The primary goal of Phase I is to demonstrate holographic imaging of programmed targets in a volume of rock using rectilinear and circular scanning systems. GRA

**N76-16413#** Control Data Corp., Minneapolis, Minn. Aerospace Div.
**ENGINEERING IMPROVEMENTS: AUTOMATED ASTRONOMIC POSITIONING SYSTEM Final Report, 28 Jun. 1974 - 28 Feb. 1975**
Joseph E. Carroll 28 Feb. 1975 121 p refs
(Contract F19628-74-C-0216; AF Proj. 4305)
(AD-A014866; AFCRL-TR-75-0156) Avail: NTIS CSCL 08/5

The Automated Astronomic Positioning System (AAPS) is a portable astrogeodetic field instrument developed to provide astronomic latitude and longitude. It is impersonal and automatic and performs most of the computations at the site using a miniature CONTROL DATA 469 Computer. These features substantially reduce the training and office computations currently required of conventional astrogeodetic methods. This is a final report covering the provisioning of spare parts and a reengineering study aimed at the recommendation of software and hardware improvements. A number of minor changes were found to significantly increase equipment usability. The incorporation of an FK4 star catalog reduces latitude offset by a factor of two. The dominant cause of random error appears to lie within the level sensor bubble and manifests itself in three forms: non-flatness of the reference surface (less than 0.5 arc second), sensitivity (not substantiated in the field). Several hardware and software modifications are recommended for incorporation, and it is further recommended that a level measurement scheme be evaluated. GRA

**N76-16414#** Stanford Research Inst., Menlo Park, Calif.
**INVESTIGATION OF A PHOTODICHROIC MATERIAL FOR HOLOGRAPHIC STORAGE AND RECOVERY Annual Technical Report, Sep. 1974 - Jul. 1975**
Matt Lehman, Thomas J. Magee, and R. A. Armistead Aug. 1975 41 p refs
(Contract N00014-72-C-0260; SRI Proj. PYU-1777)
(AD-A017509) Avail: NTIS CSCL 14/5

This report describes the experimental efforts to evaluate the influence of surface defects, temperature, and accelerated fatigue tests cycling on the properties of the ion-implanted device structures and holographic storage and recovery. Author (GRA)

**N76-16415#** Maryland Univ., College Park. Dept. of Physics and Astronomy.
**MEASUREMENT OF X-RAY CROSS SECTIONS RELEVANT**

**TO A SCANNING ION MICROSCOPE Final Report**
F. W. Martin 7 Oct. 1975 8 p
(Contract N00014-67-A-0239-0026; NR Proj. 136-925)
(AD-A017020) Avail: NTIS CSCL 14/2

The following is discussed in this report: Design and construction of a novel soft X-ray spectrometer; Integration of the spectrometer into a concurrently designed and constructed vacuum system and electronic system; Measurement of the 280 eV K X-ray emission cross section for carbon foil bombarded with 1-3 MeV carbon, nitrogen and oxygen ions; Discovery and analysis of satellite lines and solid state effects in the 270-290 eV region of spectra measured during prosecution of the above item. GRA

**N76-16416#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**DETECTION AND IDENTIFICATION OF OBJECTS EMBEDDED IN CLUTTERED FIELDS: A RECONNAISSANCE PROBLEM Ph.D. Thesis - Air Univ.**
Roger A. Gagnon May 1975 124 p refs
(AF Proj. 7233)
(AD-A017187; DS/EE/75-3) Avail: NTIS CSCL 14/5

The Air Force is concerned with the complex problems of identifying objects of interest in aerial photographs. This work is an expansion of a mathematical model of the human visual system into the realm of cluttered fields. The study considers reported modulation transfer functions (MTF) and demonstrates that the dissimilar curves can be explained by a task-related MTF. A series of aerial reconnaissance photographs are used as input to a computer-controlled flying-spot scanner. The photographs were scanned with a coarse 32 x 32 grid. The algorithm then determined those regions which contained prospective objects of interest by use of adaptive thresholds. The algorithm located 88% of the targets. A clustering algorithm was developed for the purpose of defining useful prototypes. The prototypes eliminated more than 75% of the false alarms, with no additional loss of targets, or 89% with a recognition of 82% of the detected targets. In spite of the false alarms, the process only requires 2 to 8% of the picture elements required for a television system transmission of each photo in a television frame. The 8% is for transmission of all targets and false alarms including redundant targets and false alarms obtained by the detection algorithm at several threshold levels. GRA

## 36 LASERS AND MASERS

Includes parametric amplifiers.

**N76-16417#** Joint Publications Research Service, Arlington, Va.
**LASER SOUNDING OF THE ATMOSPHERE**
9 Jan. 1976 22 p refs Transl. into ENGLISH from Tretiy Vsesoyuznyy Simpozium po Lazernomu Zondirovaniyu (Tomsk), 1974 p 201-205, 246-248, 254-257, 262-265, 287-292
(JPRS-66541) Avail: NTIS HC $3.50

Reports delivered at the Third All-Union Symposium on Laser Sounding of the Atmosphere are presented. Topics discussed include statistical testing of the ground-cloud hypothesis, replacing the standard meteorological radar by lidar, and multichannel lidar measurements. Author

**N76-16418*#** Calspan Corp., Buffalo, N.Y.
**EVALUATION OF SKYLAB EARTH LASER BEACON IMAGERY Final Report**
Kenneth R. Piech and John R. Schott Mar. 1975 102 p refs Original contains color illustrations
(Contract NAS5-20547)
(NASA-CR-144721; KL-5552-M-1) Avail: NTIS HC $5.50 CSCL 20E

During the Skylab 3 and 4 missions the Skylab spacecraft was illuminated by a low power argon ion and dye laser. The earth laser beacon was studied visually by the astronauts. In addition, they collected 35 mm hand-held color photographs of the beacons. Photographs are shown that were obtained on Skylab 3 and Skylab 4. The imagery collected during the Skylab mission was analyzed to evaluate the utility of beacon lasers as terrestial 'artificial stars' for space navigation. The analyses of the imagery revealed two unusual features of the earth laser beacon: (1) The beacon, even though of a low power (approximately 1 watt), is considerably brighter than any other terrain feature and is readily visible on imagery at a distance in excess of 1500 km (900 miles). (2) Another feature of the beacon is its large size. The typical beacon extends over about 5 resolution areas with a characteristic dimension of about 200 m. Author

**N76-16419*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**DEVELOPMENT OF A LASER DOPPLER SYSTEM FOR THE DETECTION AND MONITORING OF ATMOSPHERIC DISTURBANCES**
Harold B. Jeffreys and James W. Bilbro 28 Nov. 1975 27 p refs
(NASA-TM-X-64981) Avail: NTIS HC $4.00 CSCL 20E

A Scanning Laser Doppler Velocimeter System (SLDVS) capable of detecting and monitoring atmospheric disturbances, including wake vortices of landing aircraft and vertical wind profiles in the atmosphere was developed. The SLDVS is a focused, continuous wave, CO2 system that determines the line-of-sight velocities of particles in the focal volume by measuring the Doppler shift created by these particles. At present, the SLDVS is designed to have a range coverage of approximately 2000 ft with a vertical angle coverage of approximately 60 deg. It is also designed to detect Doppler velocities of up to 200 ft/sec with a velocity resolution of approximately 1.8 ft/sec. A complete velocity spectrum is provided by the SLDVS at each point in space at which it is focused. The overall operation and performance of the system and the description of its individual components and data handling capabilities were given. Author

**N76-16420#** Los Alamos Scientific Lab., N.Mex.
**LASER APPLICATION OF HEAT PIPE TECHNOLOGY IN ENERGY RELATED PROGRAMS**
R. J. Carbone 1975 16 p refs Presented at the 10th Intersociety Conversion Eng. Conf., Newark, Del., 17 Aug. 1975 Sponsored by ERDA
(Contract W-7405-eng-36)
(LA-UR-75-839; Conf-750812-11) Avail: NTIS HC $4.00

The design and operating parameters for a heat pipe laser utilizing metal vapors are presented. The laser would be applied to laser induced fusion, laser induced chemistry, laser isotope separation, and power transport using optical beams. NSA

**N76-16421#** Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
**SEMI-STRINGENT DERIVATION OF THE TIME DEPENDENT INTENSITY VARIATION IN DUAL-SCATTER LASER-DOPPLER-ANEMOMETRY**
L. Danielsson May 1975 6 p
(FFA-AE-1170) Avail: NTIS HC $3.50

Laser-Doppler anemometry is discussed in terms of virtual fringes formed in the intersection space of two coherent laser beams leading to correct results as far as the observed Doppler-difference frequency is concerned. The time dependent intensity variation of two interfering coherent, plane electromagnetic waves is derived. The relation of a physical treatment to the illustrative fringe-mode argumentation is discussed. ESA

**N76-16422#** European Space Agency, Paris (France).
**CALCULATION OF ELECTRONIC MACROSCOPIC PARAMETERS AND DISTRIBUTION FUNCTIONS IN CO2-N2-He PLASMAS**
Jean Bonnet, C. Dahan, G. Fournier, D. Pigache et al Nov. 1975 47 p refs Transl. into ENGLISH of "Calcul des Parametres Macroscopiques et des Fonctions de Distribution Electroniques dans les Plasmas de CO2-N2-He", ONERA, Paris Report ONERA-NT-238, 1974
(ESA-TT-204; ONERA-NT-238) Avail: NTIS HC $4.00

Many data on macroscopic parameters characterizing the electrons in CO2 laser plasmas are calculated by means of distribution functions. These exact values are compared with those obtained by an approximate method. Author (ESA)

**N76-16423#** Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

**LAMP USER'S INFORMATION, VOLUME 2 Technical Report, 8 Jul. 1974 - 30 Jun. 1975**
A. J. McDanal, Alan W. Ratliff, and Marcus L. Pearson Jun. 1975 35 p refs
(Contract DAAH01-75-C-0033; DA Proj. 1T6-62621-AH-81)
(AD-A015070; LMSC-HREC-TR-D390853-Vol-2; RK-CR-75-31-Vol-2) Avail: NTIS CSCL 20/5

The objective of this document is to present the latest Laser and Mixing Program (LAMP) user information. During the continuing development of LAMP, various modifications were made to increase its utility, efficiency, versatility and accuracy. Some of the modifications were of a purely mechanical nature; better coding techniques, etc., while others involved refinement of various input quantities (mixing and kinetic rates) based upon correlation studies. Ancillary codes which were developed to expedite LAMP inputs and provide for easier data analysis (automatic plotting, etc.), are also described herein. This report is intended to be used with Technical Report RK-CR-74-13 (AD-784531) 'Analysis of Chemical Lasers -- Volume I -- Laser and Mixing Program (LAMP) Theory and User's Guide,' June 1974. GRA

**N76-16424#** Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
**LAMP REACTION MODELS FOR ANALYSIS OF CHEMICAL LASERS, VOLUME 3 Technical Report, 8 Jul. 1974 - 30 Jun. 1975**
Shelby C. Kurzius Jun. 1975 77 p refs
(Contract DAAH01-75-C-0033; DA Proj. 1T6-62621-AG-81)
(AD-A015071; LMSC-HREC-TR-D390852-Vol-3; RK-CR-75-31-Vol-3) Avail: NTIS CSCL 20/5

Chemical kinetics inputs supporting numerical models developed for the evaluation of supersonic flow chemical laser performance are presented and discussed. The kinetics inputs are presented as fourteen state-of-the-art reaction models which have been developed explicitly for the LAMP computer code in the evaluation of HF/DF direct combustion and CO2 transfer chemical laser systems of interest. GRA

**N76-16425#** Aeronautical Research Labs., Wright-Patterson AFB, Ohio.
**PULSE AMPLIFICATION CHARACTERISTICS OF A LASER AMPLIFIER IN A MAGNETIC FIELD Interim Technical Report, 1 Mar. - 15 Apr. 1975**
Jorgen W. Birkeland Jun. 1975 30 p refs
(AF Proj. 7073)
(AD-A014728; ARL-75-0159) Avail: NTIS CSCL 20/5

This report describes and gives the results of a numerical modeling of the energy amplification characteristics of a pulsed iodine gas laser power amplifier in an applied inhomogeneous magnetic field. The purpose of the applied field is to increase the feedback limited energy storage capability of the laser medium. The lasing transition is taken to have a normal Zeeman doublet structure. Curves are presented to illustrate the parametric dependence of the energy amplification and extraction efficiency on small-signal amplification, peak field strength, and input pulse characteristics. It is shown that a 10-fold increase in output energy per pulse can be anticipated by using this technique. GRA

**N76-16426#** Frankford Arsenal, Philadelphia, Pa.
**LASER RANGEFINDING TECHNIQUES FOR HELICOPTER FIRE CONTROL APPLICATIONS. PHASE 2: NONSTABILIZED GIMBALLED LASER CONCEPT Final Test Report, Jun. - Oct. 1974**
Albert C. Cappiella Mar. 1975 39 p refs
(AD-A014942; FA-TR-75029) Avail: NTIS CSCL 19/5

The concept of employing a non-stabilized gimbal for mounting a laser rangefinder on an AH-1G helicopter was evaluated using existing hardware. The overall results indicate that this technique produced slant range errors of approximately 7% over the altitudes tested (300, 500, 1000, and 1500 feet). The evaluation showed the range error to increase significantly as operational altitude decreased. This is due to angular pointing errors translating into large slant range errors when small grazing angles are incurred. Range errors approaching 15% were projected with this system at 50-100 foot altitudes. It was also determined that the use of first pulse return logic generally produced smaller range errors than last pulse logic. In addition, a reduction in operational airspeed resulted in a slight decline in the range error. In summary, utilization of a non-stabilized gimballed laser rangefinder configuration by the copilot/gunner for helicopter fire control systems was only marginally effective at lower altitudes. The need for stabilization of the pointing system is indicated particularly under nap-of-the-earth (NOE) conditions. The addition of a stabilization capability will aid laser pointing while simultaneously allowing use of magnification to improve target detection, recognition and identification ranges. Author (GRA)

**N76-16427#** Westinghouse Research Labs., Pittsburgh, Pa.
**CW PIN DISCHARGE LASER Final Report, 15 Mar. 1973 - 30 Sep. 1974**
S. A. Wutzke, L. H. Taylor, J. L. Pack, T. V. George, and L. A. Weaver 30 Nov. 1974 135 p refs
(Contract N00014-73-C-0318; ARPA Order 1806)
(AD-A014649) Avail: NTIS CSCL 20/5

A Continuously Operating Fast Flow Electrically Excited (COFFEE) laser excitation concept was studied to determine the feasibility of scaling it to high-power levels. The concept uses a multipin-to-plane electrode configuration with transverse flow to produce a high-pressure, self-sustained glow discharge. Simultaneous approaches involving both experimental measurements and theoretical analyses were employed to develop discharge scaling criteria and a laser kinetics model. Parametric studies determined the influences of discharge current, gas velocity, pressure, mixture, electrode gap, and cathode pin spacing on input power density, specific input energy, discharge stability, and scale size. The laser kinetics were analyzed using a computer code developed for a six-temperature Boltzmann equilibrium model of CO2:N2:He:H2O gas mixtures. The model is quite general and can be applied to most CO2 flowing gas laser systems of present interest. The main conclusion of these studies is that multikilowatt COFFEE laser systems can easily be built and a solid technology base now exists for designing these systems. GRA

**N76-16428#** United Technologies Research Center, East Hartford, Conn.
**INVESTIGATION OF THE STABILITY OF LASER DISCHARGES Final Report, 22 Jan. 1973 - 28 Feb. 1975**
R. H. Bullis, W. L. Nighan, and W. J. Weigand Jun. 1975 48 p refs
(Contracts F33615-73-C-4107; N00014-72-C-0380; AF Proj. 7073)
(AD-A014737; R9216-10; ARL-75-0180) Avail: NTIS CSCL 20/5

Calculations indicate that thermal and/or vibrational instabilities will occur for most discharge conditions of importance in high power, CW carbon dioxide convection lasers. Computed characteristic growth times for these modes are typically on the order of 1 msec. The experimental investigations described herein have verified that it is the growth of disturbances in gas translational or vibrational temperature which is responsible for the discharge constriction observed in carbon dioxide laser plasmas. Moreover, because of the characteristic msec instability growth times, convection of the unstable portions of the medium out of the plasma region can effectively stabilize the discharge. The beneficial aspects of having homogeneous gas flow conditions and uniform electrical power deposition are suggested by the theory. Experimental results confirm that such plasma and fluid dynamic uniformity permits operation at increased electric power inputs and higher pressures. Extension of these results to CO lasers and electron-beam sustained plasmas is discussed. GRA

**N76-16429#** Naval Research Lab., Washington, D.C.
**ARPA-NRL LASER PROGRAM Semiannual Technical Report, 1 Jul. - 31 Dec. 1974**
Jul. 1975 36 p refs
(ARPA Order 2062)
(AD-A014861; NRL-MR-3084) Avail: NTIS CSCL 20/5

This program is concerned with three project areas: Chemical Infrared Lasers, Electrical Infrared Lasers and Electronic State Lasers. The Chemical Infrared Laser Program is concerned with the development of pulsed HCl laser systems and the study of molecular energy transfer processes. Several new sources of Cl atoms have been identified that lead to improved HCl laser

performance. Low-temperature vibrational relaxation measurements in CO2 mixtures indicate a minimum in the relaxation rates near room temperature. The Electrical Infrared Program emphasizes electric-discharge-gasdynamic lasers and electron-beam pumping of potential laser systems in the mid infrared. Energy transfer has been observed in the D2*-HCl system and a D2*-CO2 laser has been developed. A number of excitation approaches are being evaluated for application to Electronic State Lasers. Studies of direct electron-beam excitation of the Ar*-N2 laser have been completed and a sophisticated model for electron energy deposition has been developed. Optical pumping techniques, as used in the previously reported Hg vapor laser, are being extended to other atomic systems. Studies of the Hg vapor laser are essentially complete and reported here in detail. A transverse discharge Cu vapor laser has been assembled and is being tested. GRA

**N76-16430#** Naval Postgraduate School, Monterey, Calif.
**AN EXPERIMENTAL ANALYSIS OF A CYLINDRICAL SHOCK WAVE FOR USE IN A CYLINDRICAL GAS DYNAMIC LASER M.S. Thesis**
Daniel Richard Donoghue Jun. 1975 150 p refs
(AD-A014633) Avail: NTIS CSCL 20/5

The goal of this research was to experimentally demonstrate the feasibility of a cylindrical shock wave to serve as the major pressure recovery mechanism for either cylindrical gas dynamic lasers or chemical lasers. An analysis was conducted to determine the minimum distance between the nozzle exit cylinder and shock wave location, r sub m-r sub e prime, required for power extraction. A cylindrical nozzle array was designed using the axisymmetric method of characteristics for a Mach number of 4.5 with a flexibility of other Mach numbers. A chamber incorporating end wall boundary layer bleed and ejectors for back pressure control was designed and built. GRA

**N76-16431#** Hughes Research Labs., Malibu, Calif.
**PLASMA CATHODE FOR E-BEAM LASERS Semiannual Technical Report, 1 Jan. - 30 Jun. 1975**
W. Clark, G. M. Janney, and J. R. Bayless Aug. 1975 32 p refs
(Contract N00014-72-C-0496; DARPA Order 1807)
(AD-A014902; SATR-6) Avail: NTIS CSCL 20/5

The objectives of the current program are (1) to continue the development of the plasma cathode electron gun to optimize the performance characteristics and to improve reliability, and (2) to investigate the possibility of an 'integral plasma gun laser' in which a low pressure laser may be incorporated into the plasma cathode electron gun and eliminate the need for a foil window. This report describes the recent experimental results on the 4 cm x 40 cm electron gun. A lower pressure version of the plasma cathode electron gun, which was built for another contract-funded program, is described to show an important possible extended use of this kind of gun. A summary of the conclusions of the results from this reporting period is given. GRA

**N76-16432#** Holobeam, Inc., Paramus, N.J.
**HIGH EFFICIENCY TEM (SUB 100) MODE Nd: LASER STUDY PROGRAM Final Report, Jun. 1972 - Jul. 1973**
James E. Murray Jan. 1975 77 p refs
(Contract F33615-72-C-2016)
(AD-A014838; AFAL-TR-74-339) Avail: NTIS CSCL 20/6

The overall objective of this contract was to extend the state of the art of the low order mode CW Nd:YAG laser. The performance objective was a 50 watt TEM00 mode output at 1% efficiency. The first requirement in this program was to establish an unambiguous way in which to characterize low order mode beams so that any laser output beam could be measured and characterized against an absolute reference. The first part of Section II introduces such a beam characterization method. Resonators for enhanced low order mode operation are investigated in Section II. Section III describes probe beam measurements to investigate the cause of the anomalous cavity loss. They indicate the presence of a negative spherical aberration type of distortion in the thermally induced lens of a pumped YAG rod. Section IV discusses several possible ways to reduce this induced distortion. GRA

**N76-16433#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**MAGNETIC ENHANCEMENT OF THE ENERGY STORAGE CAPABILITY IN A LASER POWER AMPLIFIER Technical Report, 1 Sep. - 31 Dec. 1973**
Jorgen W. Birkeland Jun. 1975 31 p refs
(AF Proj. 7073)
(AD-A014727; ARL-75-0150) Avail: NTIS CSCL 20/5

This is the first of three reports describing an investigation of a particular technique for increasing the energy storage capability of a laser power amplifier. The problem area addressed is the energy storage limit which results from the optical gain threshold for spontaneous oscillation of the amplifier. The goal is to assess the potential of the use of a spatially inhomogeneous magnetic field to lower the peak small-signal amplification by spatially varying the frequencies of the Zeeman components of the lasing transition. This report describes and gives the results of a theoretical study of the technique applied to the photo-disassociative Iodine laser system. The hyperfine structure of the transition is included. The results show a significant increase in energy storage capability can be achieved with reasonable peak fields, depending on the line width of the individual Zeeman components. GRA

**N76-16434#** Avco-Everett Research Lab., Everett, Mass.
**METAL VAPOR VISIBLE LASER KINETICS PROGRAM Semiannual Technical Report**
D. W. Trainor, A. Mandl, and H. Hyman Mar. 1975 25 p refs
(Contract N00014-75-C-0061; ARPA Order 1806)
(AD-A014679) Avail: NTIS CSCL 20/5

The objective of the described program is to investigate experimentally and theoretically the important kinetic rate constants pertinent to the development of a high power visible laser. This research consists of three tasks. Each of the tasks are summarized: TASK I - the purpose of the first task is to identify metal atoms systems that allow selective collisional relaxation processes to efficiently quench lower levels of potential laser transitions; TASK II The purpose of the second task is to determine the efficiency of various quenchants in deactivating the upper laser level of lead; TASK III - The objective of the third task is to calculate electron impact excitation and quenching cross sections for the upper and lower laser levels of the metal atoms of interest. GRA

**N76-16435#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**EFFECT OF SLEWING ON THE FREQUENCY SPECTRUM OF A LASER BEAM IN A TURBULENT MEDIUM Physical Sciences Research Papers**
Ronald L. Fante 8 May 1975 11 p refs
(AF Proj. 2153)
(AD-A014781; AFCRL-TR-75-0259; AFCRL-PSRP-630) Avail: NTIS CSCL 20/6

The effect was investigated of slewing on the temporal frequency spectrum of the scintillations of a laser beam propagating through a turbulent medium. Author (GRA)

**N76-16436#** Naval Postgraduate School, Monterey, Calif.
**A PROPOSED METHOD TO MEASURE DIELECTRIC PROPERTIES OF NON-SPHERICAL PARTICLES USING A FABRY-PEROT INTERFEROMETER AND MULTIPASS REFLECTIVE CELL M.S. Thesis**
Anthony Raniszewski Jun. 1975 103 p refs
(AD-A014630) Avail: NTIS CSCL 20/6

A method is proposed for investigating the dielectric properties of nonspherical particles in suspension. The system employs resonance shifts of a Fabry-Perot interferometer and beam attenuation of a multipass reflective cell. The theory was developed to support this design, and experiments were conducted which verified its feasibility. Zinc oxide particles in suspension acted as a cavity perturbation and showed frequency shifts and attenuation. The method employed wavelengths of 6328A and 10.6 microns, but can be modified to use a variety of wavelengths and laser power ranges. Although zinc oxide was the only material used, the system has the potential to be used with a wide variety of particulate suspensions. Author (GRA)

**N76-16437#** Oklahoma State Univ., Stillwater. Dept. of Physics.
**GROWTH AND HARDENING OF ALKALI HALIDES FOR USE IN INFRARED LASER WINDOWS Semiannual Technical Report**
William A. Sibley 31 Oct. 1974 22 p refs
(Contract F19628-72-C-0306; AF Proj. 2055)
(AD-A015073; AFCRL-TR-74-0567; SATR-4) Avail: NTIS CSCL 20/6

A Reactive Atmosphere Process - Bridgman crystal growth system has been placed in operation. The 10.6 micrometer absorption has been measured for several KCl crystals grown in this system. The crystals show an absorption coefficient of 0.0004/cm-0.0006/cm. The effect of ionizing radiation on the 10.6 micrometer absorption of KCl has been determined. The observed absorption increase was found to be due to the F aggregate centers rather than to the Cl interstitials. GRA

**N76-16438#** Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Propulsion Directorate.
**REVIEW OF CHEMICAL LASER DIAGNOSTICS**
R. Jones 1 Mar. 1975 66 p refs
(DA Proj. 1T6-62621-AH-81)
(AD-A015505; RK-75-5) Avail: NTIS CSCL 20/5

A comprehensive survey has been made in this report of current chemical laser diagnostic techniques. In particular, measurement of excited gas species concentration and analysis of flow in the laser cavity have been reviewed. A brief description of chemical lasers and molecular spectroscopy is presented.GRA

**N76-16439#** Avco-Everett Research Lab., Everett, Mass.
**FLUORINE DISSOCIATION STUDY FOR PULSED LASERS Final Technical Report, 1 May - 31 Dec. 1974**
H. L. Chen, D. W. Trainor, W. I. Fyfe, and R. E. Center Jan. 1975 86 p refs
(Contract N00014-74-C-0367)
(AD-A015130) Avail: NTIS CSCL 20/5

Experimental results are reported for the dissociation of F2 in electron beam sustained discharges. Diagnostic techniques were developed for the measurement of transient F atom concentration with sensitivity as high as F/F2 greater than or equal to 0.00001. The sustainer enhancement factor derived from these experiments is small, and appears to be mainly due to dissociation of F2 by collisions with energetic ions. Measurements were also made of the effect of additives, such as SF6 and CF4 which exhibited negligible enhancement effect in sustained discharges. GRA

**N76-16440#** General Electric Co., Philadelphia, Pa. Reentry and Environmental Systems Div.
**AIRBREATHING LASER PROOF EXPERIMENT Final Report**
Richard E. Geiger, Donald F. Carpenter, William C. Yager, and Bernadette L. Maguire Jun. 1975 74 p refs
(Contract DAAH01-74-C-0752)
(AD-A015583) Avail: NTIS CSCL 20/5

Small signal gain and near field extracted optical power measurements have been made and the results compared with corresponding theoretical predictions in order to determine the extent to which the predicted performance of an air-breathing gas dynamic laser burning benzene or JP-4 in preheated air can be realized. An ABL test bed laser was designed for continuous operation. A J-79 low smoke combustor was adapted to the laser. Smoke temperature and gas composition measurements were made just upstream of the laser inlet. The measured smoke levels corresponded to better than 99.7% combustion efficiency. The tests included two 3.3 minute steady state lasing demonstrations during which the measured output power remained steady within the measurement accuracy. The tests were conducted at approximately 14 atmospheres over a plenum temperature range of 1263 to 1465K and at inlet temperatures of 500, 600 and 700K. Simultaneous centerline gain measurements were made 9 cm and 35 cm from the nozzle exit plane. Most of the data fell less than 10% below prediction at the 9 cm location. Benzene consistently yielded higher gain (as predicted) and the gain decay rate generally matched theoretical predictions. GRA

# 37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

**N76-16441** Missouri Univ., Columbia.
**FORCE SYSTEM SYNTHESIS TO PRODUCE A DESIRED TIME RESPONSE OF MECHANISMS Ph.D. Thesis**
Joseph Michael Halter 1975 485 p
Avail: Univ. Microfilms Order No. 76-1017

A technique and computer programs are developed which will synthesize parameters of force systems which will drive a mechanism to have a desired motion-time response and desired input-output forces. The force devices can produce linear or nonlinear forcing functions which are functions of time, pair variable position, or distance and speed between two points for one degree-of-freedom or spatial mechanisms. The parameters are synthesized by the use of a nonlinear programming technique to minimize the least-square-error of the generalized force. Penalty functions are used to constrain the range of the design parameters. Alternate physically realistic force systems that will drive a mechanism to have exactly the same desired motion-time response and/or input-output forces are presented. Design charts for alternate linear springs or dampers and their attachment points are developed. Dissert. Abstr.

**N76-16442** Rensselaer Polytechnic Inst., Troy, N.Y.
**ASYMPTOTIC METHODS IN GAS LUBRICATION THEORY FOR SLIDER BEARINGS Ph.D. Thesis**
James Anthony Schmitt 1975 166 p
Avail: Univ. Microfilms Order No. 76-1606

The method of matched asymptotic expansion is used in a manner to obtain asymptotic representations of the pressure and load carrying capacity for several different geometrically shaped gas lubricated slider bearings at high bearings numbers. The pressure for an infinitely long slider bearing is described by a second order nonlinear ordinary differential equation of the boundary value type and is analyzed for the case where the lubricating film thickness has a discontinuous first derivative. It is shown that, in addition to the boundary layer at the trailing edge, there is also a boundary layer in the derivative of the pressure at the point of discontinuity. The pressure for a finite width slider bearing is governed by a second order nonlinear elliptic partial differential equation. Its solution possesses not only boundary layers along the trailing edge and sides of the bearing but also four corner regions. A valid asymptotic representation of the pressure is obtained for the case of the linearized problem. Dissert. Abstr.

**N76-16443** Saskatchewan Univ., Saskatoon.
**ANALYTIC AND EXPERIMENTAL PREDICTION OF LIMIT CYCLE OSCILLATIONS IN AN INERTIALLY LOADED HYDRAULIC CONTROL VALVE Ph.D. Thesis**
Richard Thomas Burton 1975 164 p
Avail: Univ. Microfilms Order No. 76-731

It is proposed that limit cycle oscillations in spool type hydraulic control valves be reduced by defining the stability boundaries of the control system and ensuring that valve operation remains within this region. A simple, accurate model of a control valve and load is required from which this information may be derived. Such a model was developed, its validity under various operating conditions was determined, and its limitations were defined. The model was expressed in a transfer function form from which frequency response characteristics and stability information could be correlated with that obtained from and experimental test stand. Nonlinear valve equations were linearized using the describing function technique. The existence and stability of limit cycle oscillations were predicted from the model using conventional control theory and parameter plane techniques. The model was then compared to an experimental system consisting of a four-way valve and load. Dissert. Abstr.

**N76-16444*#** Akron Univ., Ohio. Inst. of Polymer Science.
**FRICTION AND ABRASION OF ELASTOMERIC MATERIALS Technical Report, 1 Apr. - 30 Sep. 1975**
Alan N. Gent 30 Sep. 1975 28 p refs
(Grant NsG-2061)

(NASA-CR-146128; TR-1) Avail: NTIS HC $4.00 CSCL 11J

An abrasion apparatus is described. Experimental measurements are reported for four representative elastomeric materials, including a typical high-quality tire tread material and a possible replacement material for aircraft tire treads based on transpolypentenamer (TPPR). Measurements are carried out at different levels of frictional work input, corresponding to different severities of wear, and at both ambient temperature and at 100 C. Results indicate the marked superiority in abrasion resistance of the material based on TPPR, especially at 100 C, in comparison with the other materials examined. Author

**N76-16445*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**EVALUATION OF ULTRASONICS AND OPTIMIZED RADIOGRAPHY FOR 2219-T87 ALUMINUM WELDMENTS**

W. N. Clotfelter, J. M. Hoop, and P. C. Duren 15 Nov. 1975 27 p

(NASA-TM-X-64976) Avail: NTIS HC $4.00 CSCL 13H

Ultrasonic studies are described which are specifically directed toward the quantitative measurement of randomly located defects previously found in aluminum welds with radiography or with dye penetrants. Experimental radiographic studies were also made to optimize techniques for welds of the thickness range to be used in fabricating the External Tank of the Space Shuttle. Conventional and innovative ultrasonic techniques were applied to the flaw size measurement problem. Advantages and disadvantages of each method are discussed. Flaw size data obtained ultrasonically were compared to radiographic data and to real flaw sizes determined by destructive measurements. Considerable success was achieved with pulse echo techniques and with 'pitch and catch' techniques. The radiographic work described demonstrates that careful selection of film exposure parameters for a particular application must be made to obtain optimized flaw detectability. Thus, film exposure techniques can be improved even though radiography is an old weld inspection method. Author

**N76-16446*#** National Aeronautics and Space Administration. Pasadena Office, Calif.

**HYDROGEN RICH GAS GENERATOR Patent Application**

John Houseman (JPL), Jack H. Rupe (JPL), and Raymond O. Kushida, inventors (to NASA) (JPL) Filed 20 Aug. 1973 25 p (Contract NAS7-100)

(NASA-Case-NPO-13342-1; US-Patent-Appl-SN-390049) Avail: NTIS HC $3.50 CSCL 13F

A process and apparatus is described for producing a hydrogen rich gas from liquid hydrocarbons and water by means of the steam reforming process using a partial oxidation approach. NASA

**N76-16447*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**D-1A NOSE FAIRING SEPARATION FITTING LOAD TEST**

James O. VanVleet Jan. 1976 119 p

(NASA-TM-X-71862; E-8618) Avail: NTIS HC $5.50 CSCL 13E

Structural testing of the D-1A Centaur nose fairing was completed to determine the loads imposed during flight on the latch bolts of the fairing separation system. This testing was conducted to supplement and/or verify the analytic techniques used in calculating bolt loads for the D-1A, and to gain insight into the general structural behavior of separation latch systems. It was shown that the assumed bolt load magnification due to prying action of the latch fittings on the bolt does occur, but is strongly dependent on fairing shell stiffness. Author

**N76-16448#** Gulf General Atomic, San Diego, Calif.

**PREPARATION OF SILICON NITRIDE COATINGS BY ION PLATING**

J. Chin and N. B. Elsner 9 Dec. 1975 25 p refs Presented at the Conf. on Structure-Property Relationship in Thick Film Bulk Coatings, San Francisco, 10-12 Feb. 1975

(Contract AT(04-3)-943)

(GA-A-13254; Conf-750234-1) Avail: NTIS HC $3.50

Ion plating experiments were used to deposit silicon nitride coatings on N- and P-type 85 Si-15 Mo. The presence of phosphorus in N-type 85 Si-15 Mo (which is doped beyond its solubility limit) influenced the grain size of the deposit. Mass spectrographic analyses of uncoated and coated substrates yielded phosphorus and SiO partial pressures above these substrates when they were held at 1100 C. All coatings were substoichiometric in silicon relative to Si3N4. Rates of evaporation for these coatings are plotted as a function of time at 1100 C and 10 to the -10th power torr. Sample weight loss rates were highest in uncoated controls and lowest in Si3N4-coated P-type 85 Si-15 Mo. Author (NSA)

**N76-16449#** National Bureau of Standards, Washington, D.C. Engineering Mechanics Section.

**A METHOD AND MEANS OF CALIBRATING AN AIR-BEARING FORCE PLATE FOR USE WITH A TOWED PAVEMENT FRICTION TEST TRAILER Final Report**

Robert W. Kearns and John F. Ward Dec. 1974 41 p refs Sponsored in part by Federal Highway Admin., Washington, D.C.

(COM-75-11279/7; NBSIR-75-738) Avail: NTIS HC $4.00 CSCL 13F

The equations for the variation of the external forces acting at the tire-pavement interface of a symmetrical two-wheeled towed trailer are given. Estimates, derived from experimental results, were made for the displacement of the tire-plate interface with respect to the ground of an unrestrained locked test tire on the trailer. A description of the force plate calibration test frame, instrumentation and test method is given. The means of applying simultaneous vertical (normal) and horizontal (longitudinal) forces at the contact surface of the air-bearing plate in accordance with the equations are discussed. The change in force plate output with changes in the dimensions of the trailer calibrated in-turn with the force plate are given. A method of locating the coordinate axes of the internal force sensors with respect to level is given. GRA

**N76-16450#** Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.

**TESTS OF WELDED STEEL BEAM-TO-COLUMN MOMENT CONNECTIONS**

John Parfitt, Jr. and Wai-Fah Chen Dec. 1974 63 p refs Sponsored in part by Am. Iron and Steel Inst., New York and Welding Res. Council, New York

(PB-244788/6; Lehigh/FL/333-30) Avail: NTIS HC $4.50 CSCL 13E

A test program was recently completed which had as its objective the investigation of various symmetrically-loaded moment-resisting beam-to-column connections which are of extreme importance in design and construction of steel multi-story frames This report discusses the results of three specimens included in the overall twelve-specimen program. The three connections presented are: (a) a fully-welded connection where the beam flanges and web are groove welded to the column flange, (b) a seated connection where the column flanges again are groove welded to the column flange but beam shear is carried by a beam seat which is fillet welded to the column flange, and (c) a connection in which only the flanges of the beam are groove welded to the column flange, leaving the beam flanges to carry both shear and moment. All three connections were fabricated of the same size beams and columns. GRA

**N76-16451#** Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.

**TESTS OF BOLTED BEAM-TO-COLUMN CONNECTIONS**

Kenneth F. Standig, Glenn P. Rentschler, and Wai-Fah Chen Dec. 1974 75 p refs Sponsored in part by Am. Iron and Steel Inst., New York and Welding Res. Council, New York

(PB-244810/8; Lehigh/FL/333-31) Avail: NTIS HC $4.50 CSCL 13E

A test program was recently completed which had as its objective the investigation of various symmetrically-loaded moment-resisting beam-to-column connections which are of extreme importance in the design and construction of steel multi-story frames. All specimens were fabricated of A572, Grade 55 steel. The report discusses the results of those specimens which were designed with high-strength bolts for resisting moment. There were three specimens designed and tested with bolts in bearing and one specimen with bolts in a friction (slip resistant) connection. Test results show that the bearing bolted

connections initially behave in a similar manner to previous tests. However, at a certain load, these connections exhibit a distinct difference in overall behavior. The load at which this occurs can be predicted. GRA

**N76-16452#** Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
**TEST PROGRAM OF MOMENT-RESISTANT STEEL BEAM-TO-COLUMN CONNECTIONS**
Glenn P. Rentschler and Wai-Fah Chen Dec. 1974 43 p refs Sponsored in part by Am. Iron and Steel Inst., New York and Welding Res. Council, New York
(PB-244762/1; Lehigh/FL/405-4) Avail: NTIS HC $4.00 CSCL 13E

The objective of the study was to investigate the performance of specified beam-to-column web connections under unsymmetrical loading. Although symmetrically loaded web connections are often found in the interior of building frames, the program concentrated on the more critical case of unsymmetrical loading, the type of loading normally found on the outer column line of buildings. Primary attention was focused upon the moment capacity, rotation capacity, and overall stiffness of web connections. GRA

**N76-16453#** Naval Surface Weapons Center, Dahlgren, Va.
**HIGH PRESSURE QUASI-STATIC SEAL CONFIGURATION Final Report**
W. W. Buchanan and L. E. Wicks Sep. 1975 23 p
(AD-A015083; NSWC/DL-TR-3334) Avail: NTIS CSCL 19/6

A sealing configuration has been developed to contain pressures of at least 70,000 psi. The test fixture employed possessed insufficient rigidity to consider the seal solely as static in the conventional high pressure sense. Furthermore, large seal diameters would not appear to lessen the configuration's sealing ability. Immediate application is planned in a 105mm Liquid Layer Gun scheduled for fabrication and testing in 1975. In addition, a patent application for the seal configuration is being filed. GRA

**N76-16454#** Texas A&M Univ., College Station. Coastal and Ocean Engineering Div.
**AN INVESTIGATION INTO THE PROPERTIES AND CHARACTERISTICS OF HOMOGENEOUS TAPERED CABLES**
Russell O. DeCastongrene and Richard F. Dominquez Aug. 1975 90 p refs
(Grant NOAA-04-3-158-18)
(COM-75-11219/3; COE-183; TAMU-SG-75-211; NOAA-75081104) Avail: NTIS HC $5.00 CSCL 13I

The tapered cable concept was explored and developed. The introduction is followed by a review of historical background, examination of several types of taper from a geometrical viewpoint, and the derivation of the equilibium equations pertaining to two cases of general interest: the axially suspended cable and the catenary cable configuration. These equations were used to make comparisons between the optimum, tapered cable and the common cable. Advantages and disadvantages of the tapered cable are summarized, and a set of tables is provided to assist in constant-stress catenary cable calculations. GRA

**N76-16455#** Naval Intelligence Support Center, Washington, D.C. Translation Div.
**NONLINEAR PROBLEMS OF STRESS CONCENTRATION IN MACHINE PARTS**
A. N. Grubin 16 Oct. 1975 185 p refs Transl. into ENGLISH of the book "Nelineinye Zadachi Kontsentratsii Napryazhenii v Detalyakh Mashin" Leningrad, 1972 160 p
(AD-A017308; NISC-Trans-3697) Avail: NTIS CSCL 13/9

The book reviews problems related to stress concentration in tension of such parts as blade roots, projections of turbine disks, various thread joints, etc. Analysis is presented of the state of stress under conditions of stress concentration at normal and high temperatures within the range from low to high amounts of deformation directly preceding rupture. Analytical relations are presented for calculating stresses, particularly stress concentration factors under conditions of plastic deformation and creep. Methods of evaluating general strength of machine parts subjected to given operating conditions are discussed. Localized criteria of failure, calculation examples, and their relation to experimental data are included. GRA

**N76-16456#** Illinois Univ., Urbana. Dept. of Civil Engineering.
**EFFECTS OF PLANAR WELD DEFECTS ON THE FATIGUE PROPERTIES OF 5083/5183 ALUMINUM ALLOY WELDS Milestone Cost and Progress Report, Jun. - Nov. 1975**
F. V. Lawrence 31 Oct. 1975 9 p
(Contract N00024-75-C-4504)
(AD-A017449) Avail: NTIS CSCL 13/5

The lack of penetration defects (LOP) can substantially reduce the fatigue life of these welds. The largest defects reduce the fatigue life the most. At 19 ksi., the largest LOP (2a approximately equal to 0.15 in.) can reduce the fatigue life from 80,000 cycles to 2,000 cycles. At 12 ksi., the largest LOP can reduce fatigue life from 4,000,000 cycles to 8,000 cycles. In most cases, the LOP had porosity associated with them. The fatigue crack initiation site usually includes these pores; consequently, the above data reflects the fatigue resistance of LOP with associated porosity. GRA

**N76-16457#** Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
**LUBRICANT RESERVOIR SYSTEM: THERMAL CONSIDERATIONS Interim Report**
Leon M. Dormant and Seymour Feuerstein 9 Oct. 1975 18 p refs
(Contract F04701-75-C-0076)
(AD-A017502; TR-0076(6270-30)-1; SAMSO-TR-75-239) Avail: NTIS CSCL 13/11

The thermal conditions necessary to ensure that porous nylon lubricant reservoirs properly function as lubricant replenishment sources are derived by thermodynamic methodology. The porous nylon must be warmer than its surroundings by at least an amount delta T, which may be expressed by the relation delta T=-2 gamma V T sub B rH where T sub B is the system temperature, r is the nylon pore radius, and gamma, V, and H are the surface tension, the molar volume, and the molar heat of vaporization of the liquid lubricant, respectively. GRA

# 38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

**N76-16458#** Advisory Group for Aerospace Research and Development, Paris (France).
**NON-DESTRUCTIVE INSPECTION PRACTICES, VOLUME 1**
Enrico Bolis, ed. Oct. 1975 470 p refs
(AGARD-AG-201-Vol-1; AGARDograph-201-Vol-1) Avail: NTIS HC $12.00

Nondestructive testing methods used to quarantee the safety of aircraft structures are reviewed. These methods are used in three areas: quality control, inspection of service aircraft, and as a basic element of design philosophies. Specific methods described include: magnetic particle inspection; liquid penetrant inspection; X-ray diffraction; gammagraphy; ultrasonic tests; and holographic methods. For individual titles, see N76-16459 through N76-16476.

**N76-16459** Aeritalia, Turin (Italy).
**PHILOSOPHY OF NON-DESTRUCTIVE INSPECTION**
E. Bolis *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 1-10 refs (For availability see N76-16458 07-38)

The concept of nondestructive inspection of aircraft structures is discussed in terms of two philosophies: safe life and fail safe. Factors discussed include: structural design; tolerable defects; standards of acceptance; and selection of inspection methods. A survey of nondestructive inspection techniques is given. J.M.S.

**N76-16460** George Washington Univ., Washington, D.C. School of Engineering and Applied Sciences.
**BASIC CONCEPTS IN FRACTURE MECHANICS**
J. Eftis, D. L. Jones, and H. Liebowitz *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 11-25 refs (For availability see N76-16458 07-38)

The linear elastic fracture mechanics approach to design against fracture of structural components, basically a stress intensity approach which establishes criteria for fracture instability in the presence of a crack, is presented. Emphasis is placed on design of aerospace structures. Factors discussed include: the fail-safe or fracture safe philosophy of damage tolerant structures; critical crack size; and fatigue crack growth under constant amplitude fatigue loading and variable amplitude fatigue loading. Examples are given. J.M.S.

**N76-16461** British Aircraft Corp., Weybridge (England). Commercial Aircraft Div.
**DESIGN FOR INSPECTION AND PLANNING FOR MAINTENANCE OF STRUCTURAL INTEGRITY**
H. Tyrer *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 27-54 (For availability see N76-16458 07-38)

The role of the structural and systems designer in planning for inspection and maintenance of aircraft structures is discussed. A structural inspection program which verifies the structural integrity of all aircraft in a fleet by means of visual examination and nondestructive testing is described in detail. J.M.S.

**N76-16462** Army Materials and Mechanics Research Center, Watertown, Mass.
**STANDARDS OF ACCEPTANCE BY NON-DESTRUCTIVE INSPECTION FOR RAW MATERIALS AND COMPONENTS**
Herbert F. Campbell *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 55-82 (For availability see N76-16458 07-38)

Nondestructive inspection (NDI) acceptance criteria to assure reliability of airframe materials and components are discussed. An overview is presented of responsibility, analysis requirements, and specification requirements. Materials and defect characterization, which together with service requirements form the basis for accept/reject criteria, is included. Based upon the materials and defect characterization, the action areas in the material life cycle for preparation of specifications and standards are discussed. General considerations and requirements for preparing specifications and standards are discussed. General considerations and requirements for preparing specifications and standards are presented and the various types of specifications and standards are described. Applicable specifications and standards are listed. The general formulation of the NDI program within the framework of life cycle management system is discussed together with scheduling considerations in relation to raw material, in process, final, and in service inspection. Author

**N76-16463** Royal Netherlands Aircraft Factories Fokker, Amsterdam.
**SURVEY OF PROBLEMS**
R. J. Schliekelmann *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 83-90 (For availability see N76-16458 07-38)

Problems limiting the effectiveness of nondestructive inspection (NDI) are discussed. Areas considered include: inspection of raw materials, inspection of components, and inspection of assemblies. A need for established standards in the application of NDI methods as well as in qualification and certification of NDI inspectors is indicated. J.M.S.

**N76-16464** Royal Netherlands Aircraft Factories Fokker, Amsterdam.
**CRITICAL SURVEY OF METHODS**
E. J. vanderSchee and P. F. A. Bijlmer *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 91-128 (For availability see N76-16458 07-38)

Various nondestructive test methods are described. These methods include basic techniques in the following areas: visual inspection, acoustic and ultrasonic methods, and electrical methods. The relations between the observed properties and the properties of interest are given with each method. J.M.S.

**N76-16465** Royal Netherlands Air Force, The Hague.
**QUALIFICATION OF PERSONNEL**
R. Hilverdink *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 129-139 (For availability see N76-16458 07-38)

Requirements of trained and qualified personnel that determine to a considerable extent the successful accomplishment of nondestructive testing are presented. Only general requirements are given, as specific arrangements vary not only for each process, but also for each organization which works with the process, as well as the item to be tested. Author

**N76-16466** Laboratori Centrali Fiat, Turin (Italy).
**MAGNETIC PARTICLE INSPECTION**
G. Magistrali *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 143-168 (For availability see N76-16458 07-38)

The magnetic or magnetic particle method of inspection which allows detection of surface and subsurface flaws by means of leakage magnetic fields appearing on the surface of test specimens is described. An accumulation of a particles clearly visible to the naked eye is produced, thus revealing defects not previously visible. This method is suitable only with ferromagnetic materials, such as steel, cast iron, nickel, and various ferromagnetic alloys. A summary of magnetization techniques and inspection methods is given. Author

**N76-16467** Laboratori Centrali Fiat, Turin (Italy).
**LIQUID PENETRANT INSPECTION**
Giovanni Magistrali *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 169-180 (For availability see N76-16458 07-38)

Liquid penetrant inspection which is applicable to direct surface defects or surface defects with surface openings is described. Liquids of low surface tension and with the capability of penetrating by capillary action into cracks or openings are used giving a surface indication visible to the naked eye. Author

**N76-16468** Brussels National Airport, Zaventem (Belgium).
**EDDY CURRENT NDI IN AIRLINE MAINTENANCE**
M. VanAverbeke *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 181-228 refs (For availability see N76-16458 07-38)

The theory of eddy current testing with the surface probe is discussed. Factors affecting the surface probe impedance include: conductivity variations; magnetic permeability variations; frequency variations; lift-off effect; edge effect; thinness effect; and hand capacitance effect. Other topics discussed are: sensitivity limit of eddy current testing; quantitative determination of defects; airframe holes inspection; miscellaneous airframe inspection; engine on-wing inspections; testing for corrosion; testing for conductivity; and testing of radome thickness. J.M.S.

**N76-16469** Roentgen Technische Dienst N. V., Rotterdam (Netherlands). Research and Development Dept.
**RADIOGRAPHY**
A. deSterke *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 232-259 refs (For availability see N76-16458 07-38)

Application of X-radiography to nondestructive testing of aircraft structures is discussed. The principles of radiography are given and X-ray equipment and exposure techniques described. Topics considered include: difference between the examination and inspection; practical aspects of the inspection; cracks and their performance; examination of honeycomb structures; radiographic detection and evaluation of corrosion; and radiation safety. J.M.S.

**N76-16470** Roentgen Technische Dienst N. V., Rotterdam (Netherlands).
**RADIATION SAFETY**
A. H. A. M. Roepke *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 260-267 refs (For availability see N76-16458 07-38)

The biological effects of handling the different radiation sources are discussed in terms of protection. The characteristics of radiation sources are given along with the maximum permissible

doses for individuals. Other topics discussed include: personal dosimeters; monitoring; and shielding and protection. J.M.S.

**N76-16471** Direzione Laboratori Aeronautica Militaire, Rome (Italy).
**X-RAY DIFFRACTION**
A. Tronca *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 271-292 refs (For availability see N76-16458 07-38)

The fundamental concepts of X-ray diffraction are discussed in terms of nondestructive testing of airframe materials to determine the cause of failure. The method is used to determine the amount of austenite in a hardened steel and the residual stress acting on the surface of a specimen. Other topics discussed include: determination of grain size by line-width analysis; immediate evaluation of the metallurgical state of a material; determination of preferred orientations; the use of electronic computers in processing X-ray diffraction data; and X-ray diffraction in relation to other methods of structural investigation. J.M.S.

**N76-16472** Brussels National Airport, Zaventem (Belgium).
**GAMMAGRAPHY IN AIRLINE MAINTENANCE**
M. VanAverbeke *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 295-329 refs (For availability see N76-16458 07-38)

Gammagraphy a nondestructive inspection technique derived from X-ray radiography utilizing a compact source of radioactive material is examined in relation to application in aircraft maintenance. Topics discussed include: gamma-ray properties, sources, and energy; activity of a gamma-ray source; source activity decay; radiation quantity; specific radiation intensity; gamma-ray absorption; and compton scattering. Gammagraphic photography is described in detail along with equipment and safety rules. Applications in civil aviation are given. J.M.S.

**N76-16473** Krautkraemer Branson, Inc., Stamford, Conn.
**ULTRASONIC AND ACOUSTIC METHODS**
K. G. Walther *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 331-385 refs (For availability see N76-16458 07-38)

Nondestructive test methods utilizing ultrasonics and acoustics are considered. Wall thickness measurements with ultrasonics on new material and measurement of remaining wall thickness in maintenance inspection are described along with ultrasonic inspection methods of forged parts, wrought material, and cast parts. Other topics discussed include: inspection of material connections; testing of brazed and soldered joints; ultrasonic inspection of laminates; ultrasonic inspection with surface waves; ultrasonic inspection with geometrically guided waves; ultrasonic inspection of nonmetallics; and continuous surveillance of structural members by means of ultrasonic techniques. J.M.S.

**N76-16474** Aerojet Solid Propulsion Co., Sacramento, Calif.
**DETECTION AND DETERMINATION OF FLAW SIZE BY ACOUSTIC EMISSION**
C. E. Hartbower *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 387-447 refs (For availability see N76-16458 07-38)

The use of acoustic emission as a nondestructive inspection technique is discussed. Each stage of the failure process is detected in real time starting with deformation, crack propagation, and the onset of instability. Areas of application discussed include: low cycle high-stress-intensity fatigue; stress corrosion cracking and hydrogen embrittlement; strain-aging embrittlement; delayed weld cracking; and continuous in-service surveillance. Limitations of acoustic emission techniques are summarized. J.M.S.

**N76-16475** RDE and Missile System Lab., Redstone Arsenal, Ala.
**LIQUID CRYSTAL AND NEUTRON RADIOGRAPHY METHODS**
Shelba P. Brown *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 449-470 ref (For availability see N76-16458 07-38)

Nondestructive test methods using liquid crystals to test composite structures, electronic components, and for detection of cracks in welded areas are described along with the neutron radiographic method for providing quantitative information regarding flaw location, size, shape, and orientation. Areas of application are given. J.M.S.

**N76-16476** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
**HOLOGRAPHIC METHODS**
G. E. Maddux *In* AGARD Non-Destructive Inspection Practices, Vol. 1 Oct. 1975 p 459-470 refs (For availability see N76-16458 07-38)

The principal features and aspects of the application of holography as a nondestructive test technique are considered. Methods of application examined include: surface recording, pulsed laser nondestructive inspection, ultrasonic holography, correlation methods, and speckle pattern interferometry. Holographic recording materials are briefly discussed. J.M.S.

**N76-16477#** Advisory Group for Aerospace Research and Development, Paris (France).
**NON-DESTRUCTIVE INSPECTION PRACTICES, VOLUME 2**
Enrico Bolis, ed. Oct. 1975 194 p refs
(AGARD-AG-201-Vol-2; AGARDograph-201-Vol-2) Avail: NTIS HC $7.50

Nondestructive testing methods used to quarantee the safety of aircraft structures are reviewed. Nondestructive inspection of welding, bonded structures, and composite materials is described along with measurement of residual stress and corrosion. For vol. 1, see N76-16458. For individual titles, see N76-16478 through N76-16482.

**N76-16478** Technical Univ. of Denmark, Lyngby.
**THE NON-DESTRUCTIVE MEASUREMENT OF RESIDUAL STRESSES**
F. Rotvel *In* AGARD Non-Destructive Inspection Practices Oct. 1975 p 473-505 refs (For availability see N76-16477 07-38)

The effect of mean stress on fatigue strength and stress corrosion is discussed briefly. Processes by which residual stresses are created were studied; these include plastic deformation in regions with stress gradients, temperature gradients, chemical expansion or contraction surface material, and electroplating. X-ray stress measurement using the film method of the diffractometer method was investigated, and comparisons were made between the two methods. The ultrasonic stress measuring method and the Knoop hardness stress measuring method are considered. M.J.S.

**N76-16479** Laboratori Centrali Fiat, Turin (Italy).
**NDI OF WELDING**
G. Fenoglio and G. Magistrali *In* AGARD Non-Destructive Inspection Practices Oct. 1975 p 507-528 (For availability see N76-16477 07-38)

Various types of welding techniques are briefly defined. The weldability and welding defects of titanium and its alloys, austenitic stainless steels, aluminum and its alloys, and nickel and its alloys are discussed. Typical welding defects and their detection by nondestructive testing are considered. M.J.S.

**N76-16480** Societe Nationale Industrielle Aerospatiale, Suresnes (France).
**NDI OF BONDED STRUCTURES**
M. Treca *In* AGARD Non-Destructive Inspection Practices Jan. 1975 p 529-577 refs (For availability see N76-16477 07-38)

Advantages of bonded structures are presented along with data on bonding adhesives, flaws in bonded structures, and inspection processes during product manufacture. Inspection methods which are discussed in detail include sonic inspection technique, vacuum cup inspection, ultrasonic techniques, sonic resonance, eddy sonic methods, holographic interferometry, thermal methods, and radiography. M.J.S.

**N76-16481** Air Force Materials Lab., Wright-Patterson AFB, Ohio.
**NDI OF COMPOSITE MATERIALS**
W. L. Shelton *In* AGARD Non-Destructive Inspection Practices Oct. 1975 p 579-592 refs (For availability see N76-16477 07-38)

The general problem areas of composites, the defects which

may occur in composite production and fabrication, and the nondestructive tests which are applicable for detection and measurement of such defects are reviewed. Methods discussed briefly include visual inspection, acoustic techniques, sonic methods, radiation methods, electrical methods, electromagnetic methods, and thermal methods. Author

**N76-16482** British European Airways, London (England).
**DETECTION AND MEASUREMENT OF CORROSION BY NDI**
A. R. Bond *In* AGARD Non-Destructive Inspection Practices Oct. 1975 p 593-611 (For availability see N76-16477 07-38)

Nondestructive test methods for inspecting the corrosion of aircraft structures are reviewed. The method which gave the best results was the phase sensitive eddy current method; the detectors are described in detail along with their selection and testing. M.J.S.

**N76-16483#** Kaman Sciences Corp., Colorado Springs, Colo.
**GO EVALUATION OF PWR SPRAY SYSTEM Final Report**
W. T. Long Aug. 1975 92 p refs Sponsored by Electric Power Research Inst.
(PB-245114/4; EPRI-350-1) Avail: NTIS HC $5.00 CSCL 18I

GO methodology is presented and its application demonstrated by performing a reliability analysis of a conceptual PWR containment spray system. Certain numerical results obtained are compared with those of a prior fault tree analysis of the same system. Basic data on the PWR containment spray system analyzed herein was provided in the form of schematics, functional descriptions, and subsystem failure data. Using this information, a GO model was created and exercised to ascertain the probabilities of occurrence (point estimates) of all events of interest including specifically the likelihoods of reducing pressure and removing radioactive iodine. These results do not vary significantly from those obtained in the prior study. Reasons for variations are noted. GRA

**N76-16484#** British Steel Corp., Sheffield (England). Information Services.
**THEORETICAL BASIS TO THE STUDY OF FATIGUE FAILURE TIMES IN THE ROLLING FOUR BALL TEST**
A. A. Greenfield Aug. 1975 23 p
(PB-245056/7; CDL/MT/6/74) Avail: NTIS HC $3.50 CSCL 13I

Probability theory was used to develop procedures for comparing mean lives, scatter in lifetimes, and premature deaths, with particular reference to the fatigue failure times in the rolling four ball test as used to investigate the mechanical behavior of bearing steels. Two small data sets were used to illustrate the developed procedures. The study is relevant to any problem where there is a need to estimate percentiles of age-dependent lifetime distributions. GRA

**N76-16485#** Boeing Commercial Airplane Co., Seattle, Wash.
**PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL Final Report, 15 Mar. 1973 - 15 Sep. 1974**
Howard L. Southworth, Norman W. Steele, and Peter P. Torelli Jan. 1975 187 p refs
(Contract F33615-72-C-2202; AF Proj. 7351)
(AD-A017373; D6-41978; AFML-TR-74-241) Avail: NTIS CSCL 13/8

The report describes the work accomplished under an 18-month program conducted to evaluate the sensitivity capabilities of current state-of-the-art nondestructive inspection methods. The methods include magnetic particle, penetrant, eddy-current, ultrasonic, and radiographic. These capabilities were demonstrated in response to varied surface flaws and were statistically defined in terms of probability and confidence of detection. This was accomplished with differing specimen configurations in two representative aircraft structural alloys and for both laboratory and production inspections. GRA

# 39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

**N76-16486** Toledo Univ., Ohio.
**MULTIPLE REGRESSION MODELS IN THE ANALYSIS OF COMBINED STRESS HIGH-CYCLE FATIGUE Ph.D. Thesis**
Wendell Carol Hull, Jr. 1975 284 p
Avail: Univ. Microfilms Order No. 75-29934

High cycle fatigue of metals in the presence of complex loading was studied. The test program uses statistical experimental design procedures to obtain multiple regression failure surfaces. These surfaces, in contrast to previous methods, provide an overview of large regions of failure data and represents a maximum return for experimental effort. The test regions are then readily extrapolated to indicate combined stress fatigue data trends not previously identified. The analysis of variance is used extensively to evaluate the program parameters and resulting regression surfaces. Reliability theory is used to extrapolate fatigue life for truncated specimens, and data from the literature compared with results obtained here. Specific examples are examined to show that the modified octahedral shear stress theory can be used to explain the previously observed effevts of mean shear and compressive stress in combined stress high cycle fatigue. Dissert. Abstr.

**N76-16487** State Univ. of New York, Buffalo.
**REFINED FINITE ELEMENT STABILITY ANALYSIS OF THIN-WALLED MEMBERS Ph.D. Thesis**
Ray Chen-jen Wang 1975 130 p
Avail: Univ. Microfilms Order No. 76-1473

A finite element procedure is presented for the solution to the buckling problems of thin-walled structural members. The procedure can account for the cross section distortion, and can be applied to any structure that can be discretized by an assemblage of rectangular and/or triangular elements. A displacement analysis is performed prior to the buckling analysis in order to determine the inplane stresses in the structure. These stresses are used to form the geometric stiffness of each element for the combined local and overall buckling analysis. The procedure was verified by comparing results to existing classical solutions. The published buckling strength of tapered member was also used to compare with the result from this procedure. Dissert. Abstr.

**N76-16488** Cincinnati Univ., Ohio.
**FINITE ELEMENT CYCLIC THERMOPLASTICITY ANALYSIS BY THE METHOD OF SUBVOLUMES Ph.D. Thesis**
Richard Lee McKinight 1975 143 p
Avail: Univ. Microfilms Order No. 76-744

A study was conducted to develop an analytical tool capable of economically evaluating the cyclic plasticity which occurs in areas of strain concentration resulting from the combination of both mechanical and thermal stresses. The techniques developed are capable of handling large excursions in temperatures with the associated variations in material properties, including plasticity. The techniques are capable of reproducing real cyclic material behavior including Bauschinger effect and cross-hardening. The analytical techniques developed were implemented in a time-sharing finite element computer program. Cyclic plasticity was introduced into this program using incremental loading and an iterative solution technique. The plasticity theory involved makes use of the von Mises yield criterion and the Prandtl-Reuss flow rule. The major portion of the developmental work was expended in establishing a temperature variable hardening rule and its finite element implementation. The plane stross, constant strain triangle is the finite element used. Dissert. Abstr.

**N76-16489** Cincinnati Univ., Ohio.
**STRESS ANALYSIS OF PRISMATIC SHELL STRUCTURES Ph.D. Thesis**
William Nickolas Barack 1975 158 p
Avail: Univ. Microfilms Order No. 76-743

A simply supported orthotropic circular cylindrical finite element is derived and incorporated into a finite element program SSCYL. Governing equations are based on Sanders' theory for thin shells and used in the 'semi-analytical' approach to element development. The SSCYL program can be used in the exact analysis of a circular cylindrical shell under both axisymmetric and nonsymmetric loading or in the approximate analysis of prismatic shell structures. A brief description of the SSCYL computer program is included. Numerical results and comparisons to exact analytical solutions are presented for several cases. Application is also made to the case of an airfoil cross-section cylinder. Dissert. Abstr.

**N76-16490** Utah Univ., Salt Lake City.
**STRESS CONCENTRATIONS DUE TO SURFACE HEATING OF A FINITE LENGTH THROUGH CRACK IN A THICK PLATE WITH FREE SURFACE COOLING Ph.D. Thesis**
Yih-Yi Chang 1975 90 p
Avail: Univ. Microfilms Order No. 76-1257

A study is presented on the effect of thermal stresses and temperatures on stress concentrations in the vicinity of a crack. In particular, the problem of steady state heat transfer in an infinite plate of finite thickness where the heat is generated (or removed) along the surfaces of a through crack of finite length is considered. The analysis is conducted in two parts: heat transfer and thermal stresses. General three dimensional formulations for the thermal stresses are derived from the compatibility equations. Fourier integral transformations are used to obtain solutions for both the temperature and stress fields. The results indicate that there is a 1n(r) singularity in the temperature gradient and a 1/times the square root of r singularity in the stress distribution at the crack tip. Dissert. Abstr.

**N76-16491#** Royal Aircraft Establishment, Farnborough (England).
**THE EFFECT OF SECONDARY BENDING ON THE FATIGUE STRENGTH OF JOINTS**
D. Schutz and H. Lowak Aug. 1975 74 p refs Transl. into ENGLISH from Lab. fuer Betriebsfestigkeit, Rept. FB-113 (West Ger.), 1974
(RAE-Lib-Trans-1858; BR49708; Rept-FB-113) Avail: NTIS HC $4.50

Strain measurements on complete structures and structural sections were carried out with the help of bending-strain gauges, in order to obtain information concerning the magnitude of secondary bending loads encountered on typical constructional elements of aircraft structures. In addition, an analytical method for the determination of the secondary bending load is presented and its validity investigated. In order to ascertain the effect of the secondary bending stresses on the fatigue strength of joints, constant amplitude and flight by flight tests were carried out, results of which were supplemented by an evaluation of data given in the literature. For future fatigue strength tests signal-shear joints, the results of which are to be used in a preliminary design process, a realistic value of the ratio of the secondary bending stress to the axial stress is proposed and a way is indicated by which the accuracy of the life prediction of single-shear joints can be increased. Author

**N76-16492#** Advisory Group for Aerospace Research and Development, Paris (France).
**MECHANICAL PROPERTY TESTING OF HIGH TEMPERATURE MATERIALS**
R. W. Davidge and J. Massmann Dec. 1975 34 p refs
(AGARD-R-634) Avail: NTIS HC $4.00

The Structures and Materials Panel recently initiated a new activity dealing with the field of high temperature materials. Several exploratory papers were heard covering various aspects of this field, to aid in determining the desired direction of the new activity. Two of these papers were considered particularly noteworthy. The first deals with the mechanical properties and design data of ceramic components for engineering applications. Materials science considerations are emphasized with brief reference being made to the engineering aspects. Areas requiring further development are also covered. The second paper, dealing with stress and strain calculations, shows the application of the finite element method to a structural analysis and lifetime prediction problem, and includes the calculation of stress and strain distribution at critical locations. Stress concentration factors in specimens of linear and nonlinear material, different types of yield criteria, use of Neuber and the Hardrath and Ohman Theories are examined and results are compared with the finite element method. Plasticity and creep influences are considered. For individual titles, see N76-16493 through N76-16494.

**N76-16493** Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
**THE MECHANICAL PROPERTIES AND DESIGN DATA FOR ENGINEERING CERAMICS**
R. W. Davidge *In* AGARD Mech. Property Testing of High Temp. Mater. Dec. 1975 p 1-9 refs (For availability see N76-16492 07-39)

Developments in understanding the mechanical properties of ceramics from a materials science viewpoint, and in the generation of design data for ceramics of direct applicability to engineering applications are discussed. General recommendations for further research are made. Author

**N76-16494** Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
**CALCULATION OF STRESS AND STRAIN DISTRIBUTION AT CRITICAL LOCATIONS, TAKING INTO ACCOUNT PLASTICITY AND CREEP**
Juergen Massmann *In* AGARD Mech. Property Testing of High Temp. Mater. Dec. 1975 p 10-29 (For availability see N76-16492 07-39)

The finite element method was applied to a particular structural analysis problem, the calculation of the stress and strain distribution at critical locations, which occurs in life time prediction. Some of the types of elements currently available, the selection of economical elements, and the required accuracy of the calculated results are discussed. The calculated stress concentration factor of a specimen containing a hole is presented for linear and nonlinear materials and different types of yield criteria are briefly discussed. The use of the Neuber and the Hardrath and Ohman Theories to determine the stress and strain concentration factor for nonlinear material behavior is examined, and a comparison of the results of these different theories and the Finite Element Method is given. The influence of plasticity and creep is also considered and the stress and strain concentration factor is shown as a function of creep time. Author

**N76-16495#** Canada Inst. for Scientific and Technical Information, Ottawa (Ontario).
**STEEL STRUCTURAL COLUMNS AND BEAMS UNDER HORIZONTAL LOAD AND THE BEHAVIOR OF THEIR CONNECTING PARTS, REPORT NUMBER 3**
T. Naka, T. Kato, M. Yuasa, and T. Sasaki 1975 24 p refs Transl. into ENGLISH from Nippon Kenchiku Gakkai Ronbun Hokoku-shu (Japan), v. 104, 1964 p 13-20
(ISSN-0470-2557; NRC/CNR-TT-1834; Rept-3) Avail: NTIS HC $3.50

When the connecting parts of columns and beams undergo horizontal force, the deformation and yield point of the so-called panel zone can be approximately calculated. Horizontal force to column and beam connections was repeatedly applied using a comparatively simple I-type cross section. It was ascertained that calculated deformation, yield point and yield strength of the panel zone in the elastic region was satisfactorily predicted. The calculations performed are shown. The effect on strength and decrease in rigidity of panel zones undergoing repeated loads was investigated by considering the stress distribution of the panel zone undergoing plane stress by means of a stress function. Solutions and an example of rigid frames were set up considering the deformation of the panel zone. Comparative investigations were made of the results in the case where the deformation of the panel zone is disregarded. Photographs of the panels are shown. Author

**N76-16496#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**ON SOME SINGULARITIES OF THE INSTABILITY PHENOMENON BEYOND THE ELASTIC LIMIT**
V. D. Kliushnikov 1975 5 p refs Transl. into ENGLISH from Nauka (Moscow), 1975 p 265-268
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

Buckling in elastic-plastic systems is discussed. The principle that any system for which the critical load lies in the plastic domain can be strengthened in stability respects was investigated. M.J.S.

**N76-16497*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ANALYTICAL AND EXPERIMENTAL VIBRATION STUDIES OF A 1/8-SCALE SHUTTLE ORBITER**
Larry D. Pinson Washington Dec. 1975 151 p refs
(NASA-TN-D-7964; L-9806) Avail: NTIS HC $6.75 CSCL 20K

Natural frequencies and mode shapes for four symmetric vibration modes and four antisymmetric modes are compared with predictions based on NASTRAN finite-element analyses. Initial predictions gave poor agreement with test data; an extensive investigation revealed that the major factors influencing agreement were out-of-plane imperfections in fuselage panels and a soft fin-fuselage connection. Computations with a more refined analysis indicated satisfactory frequency predictions for all modes studied, within 11 percent of experimental values. Author

**N76-16498#** National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
**NATURAL FREQUENCIES OF UNIFORM CANTILEVERS OF LIMITED SHEAR STIFFNESS**
D. W. Martin and Margaret A. Wagland May 1975 40 p refs
(NPL-NAC-49) Avail: NTIS HC $4.00

To understand the behavior of complicated structures such as tower building and tapered chimneys often assessed by reference to an equivalent cantilever of limited shear stiffness, some basic results needed in these applications are derived, relating to the strain energy of an elastic beam, the natural frequencies of a simple cantilever, with or without a mass at its tip, as well as the natural frequencies of a compound cantilever with or without a tip-mass. ESA

**N76-16499#** Aeronautical Research Inst. of Sweden, Stockholm.
**DETERMINATION OF BUCKLING AND ULTIMATE LOADS FOR CURVED PANELS SUBJECTED TO SHEAR LOADING**
V. Gamziukas 6 Sep. 1974 44 p refs
(Contract HF-INK-82223-73-009-07001)
(FFA-TN-HU-1624) Avail: NTIS HC $4.00

Static shear tests at room temperature with curved panels were carried out to determine the buckling and ultimate shear loads for curved panels of different thicknesses and with different stiffness spacings subjected to shear loading. The panels were shaped as web-beams, where the curved webs constituted the panels. The panels were reinforced by two spars, two end profiles, four rings and two stringers which were riveted to the panel plate. The dimensions of the three middle fields were identical for one and the same panel. One and the same spar cross section area but different cross section areas of rings and stringers were used in the panels. The material of the panel plate was aluminum 3526-38 and 3526-68 and of the profiles 3526-6. The relationship between shear load and total and permanent shear deformation response, buckling and ultimate shear loads were determined at the tests. The distribution of shear stresses along the panel plate was obtained only for one panel. In addition, eight tensile tests with the material of the panel plate, aluminum 3526-38 and 3526-68, were performed at room temperature in order to obtain Young's modulus, yield and ultimate stresses. Author (ESA)

**N76-16500#** National Aerospace Lab., Amsterdam (Netherlands). Div. of Structures and Materials.
**FAIL-SAFE CHARACTERISTICS OF BUILT-UP SHEET STRUCTURES**
H. Vlieger Jul. 1974 16 p refs Presented at the 9th ICAS Congr., Haifa, Israel, 25-30 Aug. 1974 Sponsored in part by Neth. Agency for Aerospace Programs
(NLR-MP-75017-U) Avail: NTIS HC $3.50

Results of analytical computations of residual strength and fatigue crack propagation characteristics of built-up sheet structures, using the strength and fatigue properties of sheet and stiffener separately, and accounting for sheet-stiffener interaction, are given. The computational results are compared with the results of tests performed on riveted specimens consisting of a 2 mm flat-sheet stiffened by symmetric strip stiffeners or eccentric z-stringers. The material of sheet and stiffener was Alclad 7075-T6. Author (ESA)

**N76-16501#** Technology, Inc., Dayton, Ohio.
**SOME THEORETICAL AND PRACTICAL ASPECTS OF THE METHOD OF FICTITIOUS LOADS IN PLANE ELASTICITY Technical Interim Report, Feb. 1974 - Apr. 1975**
Karl G. Guderley and Robert A. Thomson Jun. 1975 113 p refs Sponsored by AF
(AD-A015049; ARL-75-0170) Avail: NTIS CSCL 20/11

A major part of the report describes an implementation of the method of fictitious loads in problems of plane elasticity. The necessary formulae are compiled and partially rederived, the approximation of the operators in the resulting integral equation is discussed and some simple examples for which the solution is known are carefully examined. The method poses a number of theoretical problems, mainly centered around the degeneracy of the operator that must be inverted. One finds that for cross sections with holes certain revisions of the method must be made. One type of revision is necessary to insure the deformation field is one valued (if one follows a path around a hole). A second one must be made, because for a cross section with holes the assigned tractions usually do not satisfy certain solvability conditions. A third modification serves to remove a degeneracy in an operator for a problem in which solutions do exist. GRA

**N76-16502#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**A STRESS INTENSITY FACTOR CALIBRATION FOR CORNER FLAWS AT AN OPEN HOLE M.S. Thesis**
Johnny R. Snow May 1975 101 p refs
(AD-A015001; GAE/MC/74-13; AFML-TR-74-282) Avail: NTIS CSCL 20/12

The fatigue crack growth test was used to investigate corner flaws at holes in polymethylmethacrylate plates loaded in uniform, cyclic tension. Using baseline data and Paris' relationship, a calibration of stress intensity factor for the constant thickness, constant hole diameter specimens was made. Nondimensional stress intensity factors were plotted for crack shape values, ratios of crack length at the hole to crack length at the surface, of 1.2 to 1.6. In general, this study demonstrated lower stress intensity at the hole and higher stress intensity at the surface for larger crack sizes when compared to other researchers. It was concluded that fatigue crack growth rate testing with PMMA is a useful method of obtaining stress intensity factor calibrations for complex, three-dimensional problems where no exact solutions exist. GRA

**N76-16503#** Texas Transportation Inst., College Station.
**FORECASTING SERVICEABILITY LOSS OF FLEXIBLE PAVEMENTS Final Report, Sep. 1973 - Nov. 1974**
Danny Y. Lu, Robert L. Lytton, and William M. Moore Nov. 1974 90 p refs Prepared in cooperation with Federal Highway Admin., Washington, D.C. Sponsored by DOT
(PB-244603/7; TTI-2-8-74-57-1F) Avail: NTIS HC $5.00 CSCL 13B

Pavement performance data are analyzed in this study. Serviceability loss of three flexible pavement types due to fatigue, swelling, shrinkage and thermal cracking are correlated to many environmental, traffic, time, design and construction material variables. A 'two-step constrained select regression procedure' was developed to examine the effect that each variable has on pavement serviceability loss. Stochastic reliability concepts are applied to evaluate the expected value and variance of the serviceability loss. GRA

**N76-16504#** Transportation Research Board, Washington, D.C.
**CORROSION, CONCRETE, QUALITY CONTROL AND PAINT BEADS**
1975 119 p refs Presented at 54th Ann. Meeting of Transportation Res. Board
(PB-245568/1; TRB/TRR-539; ISBN-0-309-02390-4) Avail: NTIS HC $5.50 CSCL 13C

The papers reported are of interest to researchers and practicing engineers alike. They include (1) a discussion of the historical development of curing materials in the California Division

of Highways since 1967; (2) an examination of the effects of rapid freezing rates on the deterioration of concrete; (3) a field-testing method for measurement of the cement content of concrete using activation analysis with californium-252; (4) a description of a field test method to measure corrosion reaction rates of corrugated metal pipe; (5) an investigation of 287 galvanized culverts through visual observation and electrical tests to define the degree of corrosiveness; (6) an evaluation of corrosion investigation techniques; (7) a description of the experiences of the Pennsylvania Department of Transportation and Pennsylvania State University in the educational process to develop a program of implementing statistically oriented end-result specifications; (8) a description of the process of developing a statistically based specification for the rolling straightedge used to measure surface irregularities; (9) an examination of the precision of standard tests such as sieve analysis, percentage of crushed particles, L.A. abrasion, sand equivalent, cleanness value, durability index, and R-value through an interlaboratory correlation program; (10) an evaluation of the 2 most common types of floating beads, narrow and broad gradation; and (11) a study of the effectiveness of Missouri's traffic delineation system on both concrete and asphalt concrete pavements. GRA

**N76-16505#** Army Construction Engineering Research Lab., Champaign, Ill.
**AN ANALYTICAL MODEL FOR DETERMINING ENERGY DISSIPATION IN DYNAMICALLY LOADED STRUCTURES**
John F. McNamara and Sushil K. Sharma Oct. 1975 37 p refs Presented at the 6th Joint Meeting of the US - Japan Panel on Wind and Seismic Effects, Gaithersburg, Md., May 1974
(AD-A017040; CERL-TM-M-165) Avail: NTIS CSCL 13/13

An analytical procedure is developed which predicts nonlinear cyclic structural response under large reversals of plastic strains. The structure is discretized by means of the finite element approximation, and the material behavior is simulated by a refined analytical model which describes the realistic hysteretic stress-strain curves of A36 steel under arbitrary cycles of load. In order to test the validity of this material model some comparisons are made with experimental values of the inelastic response of a simply supported beam under cyclic bending. The model is subsequently used in the dynamic analysis of a portal frame subjected to a selection portion of the El Centro NS earthquake acceleration record. GRA

# 42 GEOSCIENCES (GENERAL)

No abstracts in this category.

# 43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

**N76-16506** Minnesota Univ., Minneapolis.
**THE EMERGING DISCIPLINE OF CARTOGRAPHY Ph.D. Thesis**
John Amadeus Wolter 1975 357 p
Avail: Univ. Microfilms Order No. 76-425

The history of cartography, historians interested in cartography, map collections, and bibliographic services, journals, societies, textbooks, and education in the subject were studied. A steady and substantial growth in these areas indicates an emerging/evolving discipline. The body of cartographic literature has been increasing at an exponential rate and shows no sign of a slackening of growth. The median citation age (half-life) of the literature has decreased, indicating a more scientific/technical character and a better defined research front. Analysis of the literature by subject and date of citations reveals the rapidly increasing importance of thematic cartography and the gradually rising importance of theoretical cartography and of societies, conferences, education and training. These factors indicate the emergence of a professional identity. Map collections are also growing and there are many more historians of cartography than before. Dissert. Abstr.

**N76-16507** Iowa State Univ. of Science and Technology, Ames.
**MULTIPLE USE RESOURCE MANAGEMENT ON NATIONAL FORESTS VIA GOAL PROGRAMMING Ph.D. Thesis**
Albert Thomas Schuler 1975 230 p
Avail: Univ. Microfilms Order No. 76-1871

Multiple use resource management on public forest land presents complex, multi-criteria decision making problems to the public resource manager. The manager is in need of a practical decision model which will enable him to integrate the available information. The goal programming model was selected as a possible decision model to be used by the resource manager. The goal programming version differs from the linear programming model in the sense that weighted deviations from goals are minimized via goal programming. The conceptual feasibility of the goal programming model was tested via an application on the Swan Creek unit. Dissert. Abstr.

**N76-16508** Pennsylvania State Univ., University Park.
**THE TRADEOFF BETWEEN ENERGY AND THE ENVIRONMENT: THE CASE OF CRUDE OIL SUPPLIES FOR CALIFORNIA Ph.D. Thesis**
Donald W. Barnett 1975 319 p
Avail: Univ. Microfilms Order No. 76-1337

A methodology is developed using linear programming as an analytical tool that ranks various energy sources in terms of their social desirability when environment, as well as production costs, are considered. The model is confined to the petroleum resources that do or could supply the California market. A comprehensive cost analysis is undertaken for eavh fuel. The objective is to minimize the cost of supplying the California market, subject to resource, sulfur, and oil spill constraints. The model is designed so the effect of the different combinations of demand, cost, sulfur content, and oil spill levels can be studied. The social desirability of an oil source is indicated by two criteria whether the source is included in the optimal solution and the size of the associated shadow price. The larger the shadow price, the greater the desirability of obtaining an increase in production of that resource. The solutions generated by the model indicated that the environmental tradeoffs can be surprisingly large, and that foreign oils can be economically and environmentally inferior to certain domestic offshore oils. Dissert. Abstr.

**N76-16509*#** Department of Industry, London (England).
**THE USE OF ERTS/LANDSAT IMAGERY IN RELATION TO AIRBORNE REMOTE SENSING FOR TERRAIN ANALYSIS IN WESTERN QUEENSLAND, AUSTRALIA Quarterly Report, period ending 31 Oct. 1975**
Monica M. Cole, Principal Investigator and E. S. Owen-Jones 31 Oct. 1975 3 p Sponsored by NASA ERTS
(E76-10086; NASA-CR-145989) Avail: NTIS HC $3.50 CSCL 08B

There are no author-identified significant results in this report.

**N76-16510*#** Mekong Committee Secretariat, Bangkok (Thailand).
**AGRICULTURE/FORESTRY HYDROLOGY Quarterly Report, Mar. 1975 - Nov. 1975**
W. J. VanDerOord, Principal Investigator Dec. 1975 12 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198 ERTS
(E76-10087; NASA-CR-145990) Avail: NTIS HC $3.50 CSCL 08F

There are no author-identified significant results in this report.

**N76-16511*#** Canada Centre for Inland Waters, Burlington (Ontario).
**DATA RETRANSMISSION VIA SATELLITES Final Report**

H. W. MacPhail, Principal Investigator [1975] 9 p Sponsored by NASA ERTS
(E76-10088; NASA-CR-145991) Avail: NTIS HC $3.50 CSCL 17B

There are no author-identified significant results in this report.

**N76-16512*#** Department of the Environment, Ottawa (Ontario). Applied Hydrology Div.
**RETRANSMISSION OF HYDROMETRIC DATA IN CANADA Progress Report, Jan. - Jun. 1975**
R. A. Halliday, Principal Investigator, I. A. Reid, and R. O. Christie Aug. 1975 12 p Sponsored by NASA ERTS
(E76-10089; NASA-CR-145992) Avail: NTIS HC $3.50 CSCL 14B

There are no author-identified significant results in this report.

**N76-16513*#** Department of the Environment, Ottawa (Ontario). Applied Hydrology Div.
**RETRANSMISSION OF HYDROMETRIC DATA IN CANADA Progress Report, 1 Apr. - 30 Sep. 1975**
R. A. Halliday, Principal Investigator and I. A. Reid Oct. 1975 12 p refs Sponsored by NASA ERTS
(E76-10090; NASA-CR-145993) Avail: NTIS HC $3.50 CSCL 14B

The author has identified the following significant results. The feasibility of transmitting hydrometric data to polar orbiting spacecraft and using these data for quasi-operational purposes was demonstrated.

**N76-16514*#** Texas A&M Univ., College Station. Remote Sensing Center.
**SPECTRAL MEASUREMENT OF WATERSHED COEFFICIENTS IN THE SOUTHERN GREAT PLAINS Progress Report, Aug. - Nov. 1975**
Bruce J. Blanchard, Principal Investigator Jan. 1976 12 p ERTS
(Contract NAS5-22534)
(E76-10091; NASA-CR-145994; RSC-3273-1) Avail: NTIS HC $3.50 CSCL 08H

There are no author-identified significant results in this report.

**N76-16515*#** Norsk Polarinstitutt, Oslo.
**GLACIOLOGICAL AND MARINE BIOLOGICAL STUDIES AT PERIMETER OF DRONNING MAUD LAND, ANTARCTICA Quarterly Report**
Olav Orheim, Principal Investigator 11 Nov. 1975 4 p Sponsored by NASA ERTS
(E76-10092; NASA-CR-145995; QR-1) Avail: NTIS HC $3.50 CSCL 08A

There are no author-identified significant results in this report.

**N76-16516*#** Meteorological Service of Canada, Ottawa (Ontario). Natural Resources Dept.
**EVALUATION OF THE FEASIBILITY OF USING THE DATA COLLECTION SYSTEM TO OPERATE A NETWORK OF HYDROLOGICAL AND CLIMATOLOGICAL STATIONS AT SITES REMOTE FROM NORMAL COMMUNICATION LINKS Final Report, Jul. 1972 - May 1974**
Raymond Perrier, Principal Investigator May 1974 15 p Sponsored by NASA ERTS
(E76-10093; NASA-CR-145996) Avail: NTIS HC $3.50 CSCL 14B

The author has identified the following significant results. The General Electric DCP has proven to be a versatile, rugged piece of hardware and has surpassed original expectation; it is very simple to use and does not require skilled staff for its use, installation, and operation. It is well suited for use in remote sites where no power is available. From this experience, it is concluded that the data collection system will be very useful in operating a network of hydrometeorological stations situated in sites remote from normal communication links.

**N76-16517*#** Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
**MAPPING ISLANDS, REEFS AND SHOALS IN THE OCEANS SURROUNDING AUSTRALIA Quarterly Report, 8 Aug. - 8 Nov. 1975**
Leonard G. Turner, Principal Investigator 8 Nov. 1975 4 p Sponsored by NASA ERTS
(E76-10094; NASA-CR-145997; QR-1) Avail: NTIS HC $3.50 CSCL 08B

The author has identified the following significant results. Comparisons of the imagery with aerial photography of areas of reefs and island and with 1:250,000 maps of coastlines indicate that the MSS imagery depicts detail to an extent which is satisfactory for 1:250,000 mapping. As the imagery does not have some of the disadvantages of aerial photography, the former should be valuable for mapping reefs, islands, and shoals. The water discoloration problem is significant as the discolored water appears to occur near shallow depths, so that confusion could arise through the misinterpretation of discolored water, when it exists, as shallow water.

**N76-16518*#** Department of Industry, London (England).
**MESOSCALE ASSESSMENTS OF CLOUD AND RAINFALL OVER THE BRITISH ISLES**
Eric C. Barrett, Principal Investigator and Colin K. Grant Dec. 1975 29 p refs Sponsored by NASA and United Kingdom Dept. of Industry ERTS
(E76-10095; NASA-CR-145998) Avail: NTIS HC $4.00 CSCL 04B

There are no author-identified significant results in this report.

**N76-16519*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**SATELLITE INFORMATION ON ORLANDO, FLORIDA**
John W. Hannah, Principal Investigator (Brevard County Planning Dept. Fla.)02(Brevard County Planning Dept., Fla.), Garland L. Thomas, and Fernando Esparza 11 Jun. 1975 25 p refs Presented at Earth Resources Survey Symp., Houston, 11 Jun. 1975 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E76-10096; NASA-TM-X-72915) Avail: NTIS HC $3.50 CSCL 05B

The author has identified the following significant results. Computer classification, accompanied by human interpretation and manual simplification, can produce land use maps which are useful on a regional, county, and for special purpose, a city basis. Change monitoring is potentially an effective application of such data at all planning levels.

**N76-16520*#** Geological Survey, Reston, Va.
**THE DELAWARE RIVER BASIN LANDSAT-DATA COLLECTION SYSTEM EXPERIMENT Final Report**
Richard W. Paulson, Principal Investigator Nov. 1975 44 p refs ERTS
(NASA Order S-70243-AG)
(E76-10097; NASA-CR-146030) Avail: NTIS HC $4.00 CSCL 08H

The author has identified the following significant results. This experiment successfully demonstrated that standard U.S. Geological Survey field instrumentation could be easily interfaced with the LANDSAT-DCS and the data made to flow smoothly to water resources management agencies. The experiment was conducted in the Delaware River basin. A truly operational system could not be deployed.

**N76-16521*#** Geological Survey, Reston, Va.
**PERFORMANCE OF THE LANDSAT-DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT Final Report**
Richard W. Paulson, Principal Investigator and Charles F. Merk Nov. 1975 29 p refs ERTS
(NASA Order S-70243-AG)
(E76-10098; NASA-CR-146031) Avail: NTIS HC $4.00 CSCL 05B

The author has identified the following significant results. This experiment was, and continues to be, an integration of the LANDSAT-DCS with the data collection and processing system of the Geological Survey. Although an experimental demonstration, it was a successful integration of a satellite relay system that is

capable of continental data collection, and an existing governmental nationwide operational data processing and distributing networks. The Survey's data processing system uses a large general purpose computer with insufficient redundancy for 24-hour a day, 7 day a week operation. This is significant, but soluble obstacle to converting the experimental integration of the system to an operational integration.

**N76-16522*#** Geological Survey, Denver, Colo. Office of Energy Resources.
**LANDSAT STUDY OF ALTERATION AUREOLES IN SURFACE ROCKS OVERLYING PETROLEUM DEPOSITS Progress Report**
T. J. Donovan, Principal Investigator 7 Nov. 1975 5 p refs Sponsored by NASA ERTS
(E76-10099; NASA-CR-146032) Avail: NTIS HC $3.50 CSCL 08G

The author has identified the following significant results. A series of low altitude underflight remote sensing experiments were flown at Cement and Davenport oil fields, Oklahoma. An experimental algorithm which employs a sinusoidal stretch of brightness values was developed and applied to a January 1973 scene (bands 4, 5, and 6) of Cement. The results, although not spectacular, are extremely encouraging and for the first time demonstrate that the alteration anomaly at Cement may be defined through enhanced LANDSAT images.

**N76-16523*#** Department of Agriculture, Washington, D.C.
**AREA SAMPLING FRAME CONSTRUCTION FOR AN AGRICULTURE INFORMATION SYSTEM WITH LANDSAT-2 DATA Progress Report, 16 Jan. - 16 Jul. 1975**
William H. Wigton, Principal Investigator Sep. 1975 10 p ERTS
(E76-10100; NASA-CR-146033) Avail: NTIS HC $3.50 CSCL 02C

There are no author-identified significant results in this report.

**N76-16524*#** Department of Agriculture, Washington, D.C.
**AREA SAMPLING FRAME CONSTRUCTION FOR AN AGRICULTURE INFORMATION SYSTEM WITH LANDSAT-2 DATA Progress Report, 17 Jul. - 17 Nov. 1975**
William H. Wigton, Principal Investiagtor Nov. 1975 3 p ERTS
(E76-10101; NASA-CR-146034) Avail: NTIS HC $3.50 CSCL 02C

There are no author-identified significant results in this report.

**N76-16525*#** Bureau of Reclamation, Denver, Colo.
**USE OF THE LANDSAT-2 DATA COLLECTION SYSTEM IN THE COLORADO RIVER BASIN WEATHER MODIFICATION PROGRAM Progress Report, 1 Jan. - 31 Mar. 1975**
Archie M. Kahan, Principal Investigator 31 Mar. 1975 11 p ERTS
(E76-10102; NASA-CR-146035) Avail: NTIS HC $3.50 CSCL 04B

The author has identified the following significant results. The LANDSAT data collection system has proven itself to be a valuable tool for control of cloud seeding operations and for verification of weather forecasts. These platforms have proven to be reliable weather resistant units suitable for the collection of hydrometeorological data from remote severe weather environments. The detailed design of the wind speed and direction system and the wire-wrapping of the logic boards were completed.

**N76-16526*#** California Earth Science Corp., Santa Monica.
**FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA Monthly Progress Report, Dec. 1975**
Paul M. Merifield, Principal Investigator Dec. 1975 2 p ref EREP
(Contract NAS2-7698)
(E76-10103; NASA-CR-146036; MPR-31) Avail: NTIS HC $3.50 CSCL 08E

There are no author-identified significant results in this report.

**N76-16527*#** Delaware Univ., Newark. Coll. of Marine Studies.
**APPLICATION OF LANDSAT TO IDENTIFY POTENTIAL ON-SHORE IMPACT OF OUTER CONTINENTAL SHELF DEVELOPMENT**
V. Klemas, Principal Investigator, J. Goodman, H. Lins, and D. Bartlett 8 Jan. 1976 2 p ERTS
(Contract NAS5-2983)
(E76-10104; NASA-CR-146037) Avail: NTIS HC $3.50 CSCL 08J

There are no author-identified significant results in this report.

**N76-16528*#** Delaware Univ., Newark.
**A COST-EFFECTIVE SATELLITE-AIRCRAFT-DROGUE APPROACH FOR STUDYING ESTUARINE CIRCULATION AND SHELF WASTE DISPERSION**
V. Klemas, Principal Investigator, G. Davis, H. Wang, W. Whelan (ITT Electro-Physics Labs., Inc.), and G. Tornatore (ITT Electro-Physics Labs., Inc.) [1975] 11 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contracts NAS5-21837; N00014-69-A-0407)
(E76-10105; NASA-CR-146038; CMS-NASA-5-75) Avail: NTIS HC $3.50 CSCL 08J

The author has identified the following significant results. Satellites, such as ERTS-1, can be used to obtain a synoptic view of current circulation over large coastal areas. Since in turbid coastal regions suspended sediment acts as a natural tracer, cost is minimized by eliminating the need for expensive injections of large volumes of dye such as Rhodamine-B. One of the principal shortcomings of satellite imaging of coastal currents was its inability to determine current magnitude and to penetrate beyond the upper few meters of the water column. These objections were overcome by complementing satellite observations with drogues tracking currents at various selected depths. By combining the satellite's wide coverage with aircraft or shore stations capable of tracking expendable drogues, a cost effective, integrated system was devised for monitoring currents over large areas, various depths, and under severe environmental conditions.

**N76-16529*#** Colorado Univ., Boulder.
**MULTIPLE RESOURCE EVALUATION OF REGION 2, US FOREST SERVICE LANDS UTILIZING LANDSAT MSS DATA Quarterly Progress Report, 1 Sep. - 30 Nov. 1975**
Paula V. Krebs, Principal Investigator and Roger M. Hoffer (Purdue Univ.) 30 Nov. 1975 31 p refs Prepared in cooperation with Purdue Univ. and Forest Service, Denver ERTS
(Contract NAS5-20948)
(E76-10106; NASA-CR-146039) Avail: NTIS HC $4.00 CSCL 08B

There are no author-identified significant results in this report.

**N76-16530*#** Colorado Univ., Boulder.
**MULTIPLE RESOURCE EVALUATION OF REGION 2, US FOREST SERVICE LANDS UTILIZING LANDSAT MSS DATA Quarterly Progress Report, 1 Jun. - 31 Aug. 1975**
Paula V. Krebs, Principal Investigator and Roger M. Hoffer (Purdue Univ.) 31 Aug. 1975 27 p refs Prepared in cooperation with Purdue Univ. and Forest Service, Denver ERTS
(Contract NAS5-20948)
(E76-10107; NASA-CR-146040) Avail: NTIS HC $3.50 CSCL 08B

There are no author-identified significant results in this report.

**N76-16531*#** California State Dept. of Water Resources, Sacramento.
**[U2 AND ERTS IMAGERY OF LAKE TAHOE AND SAN FRANCISCO BAY DELTA] Progress Report**
Randall L. Brown, Principal Investigator Oct. 1975 2 p ERTS (Contract NAS5-20945)
(E76-10108; NASA-CR-146041; QPR-1) Avail: NTIS HC $3.50 CSCL 08H

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There are no author-identified significant results in this report.

**N76-16532*#** Texas Univ., Austin.
**DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE Quarterly Report, Jun. - Aug. 1975**
Ron Jones, Principal Investigator (General Land Office, Austin, Tex.), Peggy Harwood (General Land Office, Austin, Tex.), Pat Malin (General Land Office, Austin, Tex.), Koren Sherrill (General Land Office, Austin, Tex.), Jerry Wermund, David Murphy (Texas Water Development Board, Austin), and Paul Shank (Texas Parks and Wildlife Dept., Austin) Sep. 1975 162 p refs ERTS
(Contract NAS5-20986)
(E76-10109; NASA-CR-146042) Avail: NTIS HC $6.75 CSCL 08B

There are no author-identified significant results in this report.

**N76-16533*#** Texas Univ., Austin.
**DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE Quarterly Report, Sep. - Nov. 1975**
Ron Jones, Principal Investigator (General Land Office, Austin, Tex.), Peggy Harwood (General Land Office, Austin, Tex.), Robert Finley, David Murphy (Texas Water Development Board, Austin), and Robert K. Holz Dec. 1975 60 p refs ERTS
(Contract NAS5-20986)
(E76-10110; NASA-CR-146043) Avail: NTIS HC $4.50 CSCL 08B

The author has identified the followed significant results. Techniques for interpretation of LANDSAT images were developed, along with a modified land use classification scheme.

**N76-16534*#** California Earth Science Corp., Santa Monica.
**FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA Monthly Progress Report, Nov. 1975**
Paul M. Merifield, Principal Investigator Nov. 1975 2 p refs EREP
(Contract NAS2-7698)
(E76-10111; NASA-CR-146044; MPR-30) Avail: NTIS HC $3.50 CSCL 08G

There are no author-identified significant results in this report.

**N76-16535*#** Earth Satellite Corp., Washington, D.C.
**STUDY OF MESOSCALE EXCHANGE PROCESSES UTILIZING LANDSAT AIR MASS CLOUD IMAGERY Interim Report, Sep. - Nov. 1975**
Earl S. Merritt and Romeo R. Sabatini, Principal Investigators Dec. 1975 10 p ERTS
(Contract NAS5-20944)
(E76-10112; NASA-CR-146045) Avail: NTIS HC $3.50 CSCL 04B

There are no author-identified significant results in this report.

**N76-16536*#** Army Engineer District, San Francisco, Calif.
**CALIFORNIA COAST NEARSHORE PROCESSES STUDY USING ERTS-B DATA Progress Report, 1 Sep. - 30 Nov. 1975**
Douglas M. Pirie and David D. Steller, Principal Investigators (ESCA-Tech. Corp., Long Beach, Calif.) 10 Dec. 1975 2 p ERTS
(E76-10113; NASA-CR-146046) Avail: NTIS HC $3.50 CSCL 08J

There are no author-identified significant results in this report.

**N76-16537*#** Mississippi State Office of Science and Technology, Jackson.
**APPLICATION AND EVALUATION OF SATELLITE REMOTE SENSING DATA AND AUTOMATIC PROCESSING TECHNIQUES FOR STATE-WIDE LAND USE AND OTHER RESOURCE MANAGEMENT Progress Report, period ending 21 Oct. 1975**
P. T. Bankston, Principal Investigator Oct. 1975 8 p ERTS
(Contract NAS5-20918)
(E76-10114; NASA-CR-146047) Avail: NTIS HC $3.50 CSCL 08F

There are no author-identified significant results in this report.

**N76-16538*#** Virginia Univ., Charlottesville.
**LANDSAT APPLICATION OF REMOTE SENSING TO SHORELINE-FORM ANALYSIS Quarterly Report, 4 Mar. 1975 - 6 Feb. 1976**
Robert Dolan, Principal Investigator and Jeffrey Heywood 2 Dec. 1975 7 p ERTS
(Contract NAS5-20999)
(E76-10115; NASA-CR-146048) Avail: NTIS HC $3.50 CSCL 08J

The author has identified the following significant results. Areas of the coast were selected which have historically shown vulnerability to storm damage. On Assateague Island, there are six such areas: the western tip of Fishing Point; the southern National Park Service parking lot; Smith Hammocks; Fox Hill Level; Little Fox Hill Level; and the northern five kilometers of the island. Comparative analysis of these areas with other data and with large and small scale aerial photographs shows them to be associated with large overwash fans and shoreline cusping. Initial analysis of Landsat imagery and high altitude photography indicates that the areas of high vulnerability are also associated with the angular orientation of the shoreline.

**N76-16539*#** Delaware Univ., Newark. Coll. of Marine Studies.
**STUDIES OF CURRENT CIRCULATION AT OCEAN WASTE DISPOSAL SITES**
V. Klemas, Principal Investigator, G. Davis, and R. Henry 12 Jan. 1976 2 p ERTS
(Contract NAS5-20983)
(E76-10116; NASA-CR-146049) Avail: NTIS HC $3.50 CSCL 08C

The author has identified the following significant results. Acid waste plume was observed in LANDSAT imagery fourteen times ranging from during dump up to 54 hours after dump. Circulation processes at the waste disposal site are highly storm-dominated, with the majority of the water transport occurring during strong northeasterlies. There is a mean flow to the south along shore. This appears to be due to the fact that northeasterly winds produce stronger currents than those driven by southeasterly winds and by the thermohaline circulation. During the warm months (May through October), the ocean at the dump site stratifies with a distinct thermocline observed during all summer cruising at depths ranging from 10 to 21 m. During stratified conditions, the near-bottom currents were small. Surface currents responded to wind conditions resulting in rapid movement of surface drogues on windy days. Mid-depth drogues showed an intermediate behavior, moving more rapidly as wind velocities increased.

**N76-16540*#** Environmental Research Inst. of Michigan, Ann Arbor.
**WHEAT PRODUCTIVITY ESTIMATES USING LANDSAT DATA Progress Report, 16 Aug. - 15 Nov. 1975**
Richard F. Nalepka and John Colwell, Principal Investigators 18 Dec. 1975 5 p ERTS
(Contract NAS5-22389)
(E76-10117; NASA-CR-146050; ERIM-114800-8-L) Avail: NTIS HC $3.50 CSCL 02C

The author has identified the following significant results. The biological leaf area index data show that there can be large variations in field vegetative condition from point to point. This is especially true in flood-irrigated fields, in which plant density (and development) varies drastically between rows that are in channels vs. those that are in raised areas. Considerable care must be used in interpreting the significance of isolated leaf area index measurements made from a single wheat row.

**N76-16541*#** Agriculture Dept., Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
**EXTENSIVE INVENTORY OF FOREST RESOURCES BY**

**MULTISTAGE SAMPLING Progress Report, 7 Sep. - 7 Dec.* 1975**
Robert C. Aldrich, Robert W. Dana, and Edwin H. Roberts, Principal Investigators 10 Dec. 1975 5 p ref ERTS
(NASA Order S-54053-A)
(E76-10118; NASA-CR-146051; PR-3) Avail: NTIS HC $3.50 CSCL 02F

There are no author-identified significant results in this report.

**N76-16542*#** South Dakota State Univ., Brookings. Remote Sensing Inst.
**INVESTIGATION OF REMOTE SENSING TECHNIQUES AS INPUTS TO OPERATIONAL RESOURCE MANAGEMENT MODELS Interim Report, 11 Sep. - 10 Dec. 1975**
F.A. Schmer, Principal Investigator, and R.E. Isakson Dec. 1975 27 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198 ERTS
(Contract NAS5-20982)
(E76-10119; NASA-CR-146052; SDSU-RSI-75-15) Avail: NTIS HC $3.50 CSCL 08F

There are no author-identified significant results in this report.

**N76-16543*#** Zurich Univ. (Switzerland). Dept. of Geography.
**NATURAL RESOURCES INVENTORY AND LAND EVALUATION IN SWITZERLAND Quarterly Reports**
Harold Haefner, Principal Investigator [1975] 22 p refs Sponsored by NASA Original contains color illustrations ERTS
(E76-10120; NASA-CR-146053; QR-1; QR-2) Avail: NTIS HC $3.50 CSCL 08F

The author has identified the following significant results. A system was developed to operationally map and measure the areal extent of various land use categories for updating existing and producing new and actual thematic maps showing the latest state of rural and urban landscapes and its changes. The processing system includes: (1) preprocessing steps for radiometric and geometric corrections; (2) classification of the data by a multivariate procedure, using a stepwise linear discriminant analysis based on carefully selected training cells; and (3) output in form of color maps by printing black and white theme overlays of a selected scale with photomation system and its coloring and combination into a color composite.

**N76-16544*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA Progress Report, 12 Aug. - 11 Nov. 1975**
John W. Hannah (Brevard County Planning Dept., Fla.), Garland L. Thomas, and Fernado Esparza, Principal Investigators 11 Nov. 1975 20 p ref ERTS
(Contract NAS5-20907)
(E76-10121; NASA-TM-X-72916) Avail: NTIS HC $3.50 CSCL 08B

There are no author-identified significant results in this report.

**N76-16545*#** Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
**APPLICATION OF LANDSAT TO THE SURVEILLANCE AND CONTROL OF LAKE EUTROPHICATION IN THE GREAT LAKES BASIN Progress Report, Nov. 1975 - Jan. 1976**
Robert H. Rogers, Principal Investigator Jan. 1976 25 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-20942)
(E76-10122; NASA-CR-146055) Avail: NTIS HC $3.50 CSCL 08H

There are no author-identified significant results in this report.

**N76-16546*#** Agricultural Research Service, Weslaco, Tex.
**SOIL, WATER, AND VEGETATION CONDITIONS IN SOUTH TEXAS Quarterly Progress Report, 13 Oct. 1975 - 13 Jan. 1976**
Craig L. Wiegand, Harold W. Gausman, Ross W. Leamer, and Arthur J. Richardson, Principal Investigators Jan. 1976 17 p refs ERTS
(NASA Order S-53876-AG)
(E76-10123; NASA-CR-146056) Avail: NTIS HC $3.50 CSCL 08F

The author has identified the following significant results. Reflectance differences between the dead leaves of six crops (corn, cotton, sorghum, sugar cane, citrus, and avocado) and the respective bare soils where the dead leaves were lying on the ground were determined from laboratory spectrophotometric measurements over the 0.5- to 2.5 micron wavelength interval. The largest differences were in the near infrared waveband 0.75- to 1.35 microns. Leaf area index was predicted from plant height, percent ground cover, and plant population for irrigated and nonirrigated grain sorghum fields for the 1975 growing season.

**N76-16547*#** Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
**COMPUTER MAPPING OF WATER QUALITY IN SAGINAW BAY WITH LANDSAT DIGITAL DATA Special Report**
R. H. Rogers, Principal Investigator, N. J. Shah, V. E. Smith, and J. B. McKeon Jan. 1976 15 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-20942)
(E76-10124; NASA-CR-146057; BSR-4213) Avail: NTIS HC $3.50 CSCL 08H

The author has identified the following significant results. LANDSAT digital data and ground truth measurements for Saginaw Bay (Lake Huron), Michigan, for 31 July 1975 were correlated by stepwise linear regression and the resulting equations used to estimate invisible water quality parameters in nonsampled areas. Chloride, conductivity, total Kjeldahl nitrogen, total phosphorus, and chlorophyll a were best correlated with the ratio of LANDSAT Band 4 to Band 5. Temperature and Secchi depth correlate best with Band 5.

**N76-16548*#** Texas A&M Univ., College Station.
**APPLIED REGIONAL MONITORING OF THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION IN THE GREAT PLAINS CORRIDOR Progress Report, Aug. - Oct. 1975**
John W. Rouse, Jr., Principal Investigator Nov. 1975 31 p refs ERTS
(Contract NAS5-20796)
(E76-10126; NASA-CR-146059; RSC-3018-3) Avail: NTIS HC $4.00 CSCL 08F

There are no author-identified significant results in this report.

**N76-16549*#** Texas A&M Univ., College Station. Remote Sensing Center.
**APPLIED REGIONAL MONITORING OF THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION IN THE GREAT PLAINS CORRIDOR Progress Report, May - Jul. 1975**
John W. Rouse, Jr., Principal Investigator Oct. 1975 21 p refs ERTS
(Contract NAS5-20796)
(E76-10127; NASA-CR-146060; RSC-3018-2) Avail: NTIS HC $3.50 CSCL 08F

There are no author-identified significant results in this report.

**N76-16550*#** Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
**A STUDY OF THE USEFULNESS OF SKYLAB EREP DATA FOR EARTH RESOURCES STUDIES IN AUSTRALIA Final Report**
B. P. Lambert, M. L. Benson, C. J. Borough, B. J Myers, C. E. Maffi, C. J. Simpson, W. J. Perry, K. L. Burns, J. Shepherd, R. Beattie, Principal Investigators et al Jul. 1975 113 p refs Sponsored by NASA and Dept. of Sci. and Consumer Affairs, Australia Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(E76-10128; NASA-CR-144493) Avail: NTIS HC $5.50 CSCL 05B

The author has identified the following significant results. In subhumid, vegetated areas, S190B photography: (1) has a potentially operational role in detecting lineaments in 1:100,000 scale geological mapping and in major civil engineering surveys; (2) is of limited value for regional lithological mapping at 1:500,000 scale; and (3) provided much useful synoptic information and some detailed information of direct value to the mapping of nonmineral natural resources such as vegetation, land soil, and water. In arid, well exposed areas, S190B photography could be used: (1) with a limited amount of field traverses, to produce reliable 1:500,000 scale geological maps of sedimentary sequences; (2) to update superficial geology on 1:250,000 scale maps; and (3) together with the necessary field studies, to prepare landform, soil, and vegetation maps at 1:1,000,000 scale. Skylab photography was found to be more useful than LANDSAT images for small scale mapping of geology and land types, and for the revision of topographic maps at 1:100,000 scale, because of superior spatial resolution and stereoscopic coverage.

**N76-16551*#** Naval Research Lab., Washington, D.C. Space Science Div.

**SKYLAB ALTIMETER OBSERVATIONS OVER TERRAIN Final Report**

Allan Shapiro, June M.. Thormodsgard, and J. M. Okada, Principal Investigators Sep. 1975 159 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order T-4716-B)

(E76-10129; NASA-CR-144498) Avail: NTIS HC $6.75 CSCL 08B

The author has identified the following significant results. Data obtained by Skylab radar altimeter (S193) over the continental U.S.A. for pass 1 of SL-3 were analyzed to relate radar return signal parameters such as range, power, and waveform to ground track terrain features. The altimeter, which was originally designed for ocean observations, performed predictably well over terrain with moderate to low relief. The maximum return from more complex areas corresponded usually to the lower flatter regions within the seven kilometer diameter footprint. Altimeter measured heights correlated with map topography with an rms deviation of + or - 30 m for terrain topography with large height dispersion (passes 1 and 28) and + or - 5 m for slowly varying terrain (passes 16, 17, and 18). Analysis of the waveform and statistical characteristics of the individual signals indicated that larger signal power was usually related to dominantly specular reflections from patches 100 m or larger. Results established the capability of a spacecraft altimeter system to observe characteristic radar signatures for different types of terrain within the bandwidth restrictions of the AGC and range tracker loops.

**N76-16552*#** Environmental Research Inst. of Michigan, Ann Arbor.

**S-192 ANALYSIS: CONVENTIONAL AND SPECIAL DATA PROCESSING TECHNIQUES Final Report, 8 Mar. 1973 - 30 Sep. 1975**

R. F. Nalepka, Principal Investigator, J. Morganstern, R. Cicone, J. Sarno, P. Lambeck, and W. Malila Sep. 1975 186 p refs EREP

(Contract NAS9-13280)

(E76-10130; NASA-CR-144506; ERIM-101900-63-F) Avail: NTIS HC $7.50 CSCL 05B

The author has identified the following significant results. Multispectral scanner data gathered over test sites in southeast Michigan were analyzed. This analysis showed the data to be somewhat deficient especially in terms of the limited signal range in most SDOs and also in regard to SDO-SDO misregistration. Further analysis showed that the scan line straightening algorithm increased the misregistration of the data. Data were processed using the conic format. The effects of such misregistration on classification accuracy was analyzed via simulation and found to be significant. Results of employing conventional as well as special, unresolved object, processing techniques were disappointing due, at least in part, to the limited signal range and noise content of the data. Application of a second class of special processing techniques, signature extension techniques, yielded better results. Two of the more basic signature extension techniques seemed to be useful in spite of the difficulties.

**N76-16553*#** Agricultural Research Service, Weslaco, Tex.

**SOIL SALINITY DETECTION Final Report, 13 Mar. 1973 - 31 Jul. 1975**

Craig L. Wiegand, Arthur J. Richardson, Harold W. Gausman, Ross W. Leamer, Alvin H. Gerbermann, James H. Everitt, and Jose A. Cuellar, Principal Investigators Jul. 1975 50 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order T-4105-B)

(E76-10131; NASA-CR-144403) Avail: NTIS HC $4.00 CSCL 08M

The author has identified the following significant results. Growth forms and herbage biomass production varied considerably among saline and nonsaline soil range sites in Starr County. Grasses on saline soil sites were shallow-rooted and short whereas on nonsaline sites there was an intermixture of short and midgrass species. Differentiation between primarily undisturbed saline and nonsaline rangelands, in Starr County, is partially possible using film optical density readings from Skylab imagery. Differentiation among eight saline and nonsaline soil sites in Cameron County, using black and white and color film was not possible according to statistical results from both DMRT and correlation analysis. Linear analysis showed that Bendix 24-band MSS data (aircraft) collected at 1700 m and 4800 m, as well as Skylab and LANDSAT-1 MSS data, were significantly correlated to electrical conductivity readings. In Starr County, the best spectral band for detection of saline soil levels, using black and white SO-022 film, was in the 0.6 to 0.7 micron spectral region. In Cameron County, the best spectral bands for detection of saline soil levels were the 2.3 to 2.43 micron, 0.72 to 0.76 micron, 0.69 to 1.75 micron, and 0.7 to 1.1 micron spectral regions.

**N76-16554*#** Dartmouth Coll., Hanover, N.H.

**AN INVESTIGATION OF THERMAL ANOMALIES IN THE CENTRAL AMERICAN VOLCANIC CHAIN AND EVALUATION OF THE UTILITY OF THERMAL ANOMALY MONITORING IN THE PREDICTION OF VOLCANIC ERUPTIONS Final Report**

Richard E. Stoiber, Principal Investigator and William I. Rose, Jr. (Michigan Technological Univ.) Jul. 1975 81 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13311; Grant NSF GA-26026)

(E76-10132; NASA-CR-144496) Avail: NTIS HC $5.00 CSCL 08F

The author has identified the following significant results. Ground truth data collection proves that significant anomalies exist at 13 volcanoes within the test site of Central America. The dimensions and temperature contrast of these ten anomalies are large enough to be detected by the Skylab 192 instrument. The dimensions and intensity of thermal anomalies have changed at most of these volcanoes during the Skylab mission.

**N76-16555*#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

**OIL POLLUTION DETECTION AND MONITORING FROM SPACE USING SKYLAB Final Report**

Gary C. Goldman and Robert Horvath, Principal Investigators Nov. 1975 44 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13281)

(E76-10133; NASA-CR-144502; ERIM-101800-20-F) Avail: NTIS HC $4.00 CSCL 13B

There are no author-identified significant results in this report.

**N76-16556*#** Kansas Univ. Center for Research, Inc., Lawrence. Atmospheric Science Lab.

**DETECTION OF SOIL MOISTURE AND SNOW CHARACTERISTICS FROM SKYLAB Final Report**

Joe R. Eagleman, Principal Investigator, Wen Lin, Norman Hardy, Richard Sloan, Surrenda Parashar, Charles Perry, Larry League, Margaret Engling, Ernest C. Pogge, and Richard K. Moore Oct. 1975 313 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13273)
(E76-10134; NASA-CR-144485; FR-239-23) Avail: NTIS HC $9.75 CSCL 08M

The author has identified the following significant results. The most significant result is the good response of the passive radiometers, particularly the L-band radiometer, to changing soil moisture conditions near the surface of the earth. Radiometer response was very good for the five complete data sets consisting of three passes across Texas and two passes across Kansas. When data from the five different passes were combined, the correlation between the S194 radiometric temperature and soil moisture content remained high with a value of -0.96. The performance of the S193 passive radiometer was less consistent; however, one data set gave a very high correlation of -0.95. The scatterometer response to soil moisture at incidence angles near 30 deg was not as good as for the radiometers.

**N76-16557*#** Earth Satellite Corp., Berkeley, Calif.
**PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY. ASSESSMENT OF NATURAL VEGETATION, ENVIRONMENTAL, AND CROP ANALOGS Final Report**
Charles E. Poulton, Principal Investigator and Robin I. Welch Dec. 1975 262 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13286)
(E76-10135; NASA-CR-144484; G-089) Avail: NTIS HC $9.00 CSCL 08B

The author has identified the following significant results. For interpreting a wide range of natural vegetation analogs, S-190A color infrared and the ERTS-1 color composite were consistently more useful than were conventional color or black and white photos. Color infrared was superior for five vegetation analogs while color was superior for only three. The errors in identification appeared to associate more with black and white single band images than with multiband color. For rice crop analogs, spectral and spatial discriminations both contribute to the usefulness of images for data collection. Tests and subjective analyses conducted in this study indicated that the spectral bands exploited in color infrared film were the most useful for agricultural crop analysis. Accuracy of crop identification on any single date of Skylab images was less than that of multidate analysis due to differences in crop calendar, cultural practices used, rice variety, planting date, planting method, water use, fertilization, disease, or mechanical problems.

**N76-16558*#** South Carolina State Development Board, Columbia. Div. of Geology.
**APPLICATION OF MULTISPECTRAL PHOTOGRAPHY TO MINERAL AND LAND RESOURCES OF SOUTH CAROLINA Final Report**
Norman K. Olson, Principal Investigator 27 Jun. 1975 76 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. EREP
(Contract NAS8-29617)
(E76-10136; NASA-CR-144109) Avail: NTIS HC $5.00 CSCL 08F

The author has identified the following significant results. Good results were obtained from using Skylab photography in conjunction with LANDSAT imagery for visual interpretation of various geologic features, particularly lineaments. It was concluded that visual interpretation alone of Skylab photographs was quite limited, and much of this was because of the low contrast, heavily vegetated terrain in southeastern United States. Lineaments of major structural features are detectable but subtle. An intimate knowledge of the geologic field relationships is needed before a meaningful analysis is feasible using current satellite photography alone.

**N76-16559*#** South Dakota State Univ., Brookings. Remote Sensing Inst.
**USE OF REMOTE SENSING TECHNOLOGY FOR INVENTORYING AND PLANNING UTILIZATION OF LAND RESOURCES IN SOUTH DAKOTA Annual Progress Report, 1 Jul. 1974 - 30 Jun. 1975**
30 Jun. 1975 52 p refs
(Grant NGL-42-003-007)
(NASA-CR-146144) Avail: NTIS HC $4.50 CSCL 08B

A project was undertaken in Meade County, South Dakota to provide (1) a general county-wide resource survey of land use and soils and (2) a detailed survey of land use for the environmentally sensitive area adjacent to the Black Hills. Imagery from LANDSAT-1 was visually interpreted to provide land use information and a general soils map. A detailed land use map for the Black Hills area was interpreted from RB-57 photographs and interpretations of soil characteristics were input into a computer data base and mapped. The detailed land use data were then used in conjunction with soil maps to provide information for the development of zoning ordinance maps and other land use planning in the Black Hills area. The use of photographs as base maps was also demonstrated. In addition, the use of airborne thermography to locate spoilage areas in sugar beet piles and to determine the apparent temperature of rooftops was evaluated. Author

**N76-16560*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**SKYLAB 4 VISUAL OBSERVATIONS PROJECT REPORT**
J. L. Kaltenbach, W. B. Lenoir, M. C. McEwen, R. A. Weitenhagen, and V. R. Wilmarth Jun. 1974 249 p
(NASA-TM-X-58142; JSC-09053) Avail: NTIS HC $8.00 CSCL 22A

The Skylab 4 Visual Observations Project was undertaken to determine the ways in which man can contribute to future earth-orbital observational programs. The premission training consisted of 17 hours of lectures by scientists representing 16 disciplines and provided the crewmen information on observational and photographic procedures and the scientific significance of this information. During the Skylab 4 mission, more than 850 observations and 2000 photographs with the 70-millimeter Hasselblad and 35-millimeter Nikon cameras were obtained for many investigative areas. Preliminary results of the project indicate that man can obtain new and unique information to support satellite earth-survey programs because of his inherent capability to make selective observations, to integrate the information, and to record the data by describing and photographing the observational sites. Author

**N76-16561*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS**
Albert Rango, ed. Washington 1975 430 p refs Proc. held at South Lake Tahoe, Calif., 18-20 Aug. 1975; sponsored by NASA and Nevada Univ.
(NASA-SP-391) Avail: NTIS HC $11.75 CSCL 08L

LANDSAT and NOAA satellites data were used to study snow depth. These snow measurements were used to help forecast runoff and flooding. Many areas of California, Arizona, Colorado, and Wyoming were emphasized. For individual titles, see N76-16562 through N76-16590.

**N76-16562*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**AN OVERVIEW OF THE APPLICATIONS SYSTEMS VERIFICATION TEST ON SNOWCOVER MAPPING**
A. Rango *In its* Operational Appl. of Satellite Snowcover Observations 1975 p 1-12 refs (For availability see N76-16561 07-43)
(Paper-1) CSCL 08L

The capability of the LANDSAT and NOAA satellites to accurately measure snowcovered area on various size watersheds was demonstrated. Recent research has shown a highly significant statistical relationship between satellite-derived snowcovered area at the beginning of the snowmelt period and seasonal runoff. The decision was made to test the results of several satellite snowcovered area studies in an Applications Systems Verification

Test (ASVT) Program where quasi-operational evaluations of total technical capability are performed. The objective of these ASVT's is to provide all the information necessary for a potential user to make effective decisions concerning the implementation of the new remote sensing technology in an operational applications system. Author

**N76-16563*** Geological Survey, Phoenix, Ariz.
**OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS AND LANDSAT DATA COLLECTION SYSTEMS OPERATIONS IN CENTRAL ARIZONA**
Herbert H. Schumann *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 13-28 refs (For availability see N76-16561 07-43)
(Paper-2) CSCL 08L

Repetitive LANDSAT and NOAA-4 satellite imagery together with aerial surveys are being evaluated to develop an operational capability for mapping snowcover distributions on the Salt-Verde watershed of central Arizona. Satellite telemetry is also being used for near-real time relay of hydrologic data to aid in the management and operation of reservoirs on the Salt and Verde Rivers. Aerial reconnaissance flights were conducted to collect information on the depth and distribution of snowcover to provide ground truth for use in the analysis of the satellite imagery. A technique for rapid and economical determination of snow depths, using oblique aerial photography of snow markers, was developed. Author

**N76-16564*** Salt River Project, Phoenix, Ariz.
**THE APPLICATION OF HYDROMETEOROLOGICAL DATA OBTAINED BY REMOTE SENSING TECHNIQUES FOR MULTIPURPOSE RESERVOIR OPERATIONS**
W. L. Warskow, T. T. Wilson, Jr., and K. Kirdar *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 29-37 refs (For availability see N76-16561 07-43)
(Paper-3) CSCL 08L

Watershed snowpack and streamflow data obtained and transmitted by (ERTS) satellite were used in the operational and water management decisions in the Salt River Project. Located in central Arizona, the Project provides water and electric power for the more than 1.1 million residents of the Salt River Valley. The water supply source is a 33,670 square kilometer (13,000 square mile) watershed and 250 deep well pumps. Six storage reservoirs, four of which have hydroelectric capability, located on two river systems have a storage capacity of over 246,600 hectare-meters (2,000,000 AF.). Information from the watershed during the normal runoff period of December to May and more especially during critical periods of high runoff and minimum reservoir storage capacity is necessary for the reservoir operation regimen. Extent of the snowpack, depth of snow, and the condition of the pack were observed in aerial flights over the watershed. Author

**N76-16565*** Sierra Hydrotech, Placerville, Calif.
**INTERPRETATION OF SNOWCOVER FROM SATELLITE IMAGERY FOR USE IN WATER SUPPLY FORECASTS IN THE SIERRA NEVADA**
A. J. Brown (California Dept. of Water Resources, Sacramento) and J. F. Hannaford *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 39-51 (For availability see N76-16561 07-43)
(Paper-4) CSCL 08L

The California ASVT test area is composed of two study areas; one in Northern California covering the Upper Sacramento and Feather River Basins, and the other covering the Southern Sierra Basins of the San Joaquin, Kings, Kaweah, Tule, and Kern Rivers. Experiences of reducing snowcover from satellite imagery; the accuracy of present water supply forecast schemes; and the potential advantages of introducing snowcover into the forecast procedures are described. Author

**N76-16566*** Soil Conservation Service, Denver, Colo.
**OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS IN RIO GRANDE DRAINAGE OF COLORADO**
Jack N. Washicheck and Tony Mikesell *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 53-69 (For availability see N76-16561 07-43)
(Paper-5) CSCL 08L

Various mapping techniques were tried and evaluated. There were many problems encountered such as distinquishing clouds from snow and snow under trees. A partial solution to some of the problems involves ground reconnaissance and low air flights. Snow areas, cloud cover, and total areas were planimetered after transferring imagery by use of zoom transfer scope. These determinations were then compared to areas determined by use of a density slicer. Considerable adjustment is required for these two values to compare. NOAA pictures were also utilized in the evaluation. Forest cover is one of the parameters used in the modeling process. The determination of this percentage is being explored. Author

**N76-16567*** Bonneville Power Administration, Portland, Oreg. Hydrology Section.
**OPERATIONAL APPLICATION OF SATELLITE SNOWCOVER OBSERVATIONS, NORTHWEST UNITED STATES**
Fred A. Limpert *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 71-85 refs (For availability see N76-16561 07-43)
(Paper-6) CSCL 08L

A demonstration project was undertaken in the Pacific Northwest to determine the applicability of satellite snowcover observations for operational use in three test areas of the Columbia River Basin. Author

**N76-16568*** National Oceanic and Atmospheric Administration, Washington, D.C.
**THE OPERATIONAL PROGRAM OF SATELLITE SNOWCOVER OBSERVATIONS AT NOAA/NESS**
Stanley R. Schneider *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 87-101 refs (For availability see N76-16561 07-43)
(Paper-7) CSCL 08L

The operational river basin snow mapping program at NESS is described with emphasis on quality control techniques and results for the 1974-1975 snow season. Author

**N76-16569*** Arizona Univ., Tucson.
**USE OF AREAL SNOW COVER MEASUREMENTS FROM ERTS-1 IMAGERY IN SNOWMELT-RUNOFF RELATIONSHIPS IN ARIZONA**
J. S. Aul and P. F. Ffolliott *In* NASA. Goddard Spac3 Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 103-112 refs (For availability see N76-16561 07-43)
(Paper-8) CSCL 08L

Methods of interpreting ERTS-1 imagery to measure areal snow cover were analyzed. Relationship of areal snow cover and runoff were among the objectives in this study of ERTS-1 imagery use for forecasting snowmelt-runoff relationships. Author

**N76-16570*** Wyoming Univ., Laramie.
**UTILIZATION OF LANDSAT MONITORING CAPABILITIES FOR SNOWCOVER DEPLETION ANALYSIS**
A. G. Thompson *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 113-127 refs (For availability see N76-16561 07-43)
(Paper-9) CSCL 08L

LANDSAT images for three snowmelt seasons were utilized to map and analyze snowcover depletion on a small river basin in southeastern Wyoming. Results indicate that snowcover-runoff curves established from repetitive LANDSAT coverage may be used in conjunction with streamflow data to provide low-cost seasonal runoff forecasts having a high degree of accuracy. Additionally, detectable variations within a snowpack might provide temporal estimates of peak flows. Author

**N76-16571*** California Univ., Berkeley.
**OPERATIONAL USE OF LANDSAT IMAGERY FOR THE ESTIMATION OF SNOW AREAL EXTENT**
Edwin F. Katibah *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 129-142 refs (For availability see N76-16561 07-43)
(Grant NGL-05-003-404)
(Paper-10) CSCL 08L

Quantification of the surface area of snow covering watersheds can be a useful parameter in estimating snow water content for inclusion in water runoff prediction equations. An operational manual interpretation technique is described, which allows fast and accurate estimates to be made of the areal extent of snow parameter using LANDSAT-1 imagery. The analysis procedures and the statistical results are presented. Author

**N76-16572*** Alaska Univ., Fairbanks. Inst. of Water Resources.
**OPERATIONAL APPLICATIONS OF NOAA-VHRR IMAGERY IN ALASKA**
R. D. Seifert, R. F. Carlson, and D. L. Kane *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 143-155 refs Sponsored in part by NOAA (For availability see N76-16561 07-43)
(Paper-11) CSCL 08L

Near-real time operational applications of NOAA satellite enhanced thermal infrared imagery to snow monitoring for river flood forecasts, and a photographic overlay technique of imagery to enhance snowcover are presented. Ground truth comparisons show a thermal accuracy of approximately + or - 1 C for detection of surface radiative temperatures. The application of NOAA imagery to flood mapping is also presented. Author

**N76-16573*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EMPLOYMENT OF SATELLITE SNOWCOVER OBSERVATIONS FOR IMPROVING SEASONAL RUNOFF ESTIMATES**
A. Rango, V. V. Salomonson, and J. L. Foster (Maryland Univ., College Park) *In its* Operational Appl. of Satellite Snowcover Observations 1975 p 157-174 refs Sponsored in part by NOAA (For availability see N76-16561 07-43)
(Paper-12) CSCL 08L

Low resolution meteorological satellite and high resolution earth resources satellite data were used to map snowcovered area over the upper Indus River and the Wind River Mountains of Wyoming, respectively. For the Indus River, early Spring snowcovered area was extracted and related to April through June streamflow from 1967-1971 using a regression equation. Composited results from two years of data over seven Wind River Mountain watersheds indicated that LANDSAT-1 snowcover observations, separated on the basis of watershed elevation, could also be related to runoff in significant regression equations. It appears that earth resources satellite data will be useful in assisting in the prediction of seasonal streamflow for various water resources applications, nonhazardous collection of snow data from restricted-access areas, and in hydrologic modeling of snowmelt runoff. Author

**N76-16574*** Leaf (Charles F.), Fort Collins, Colo.
**APPLICATIONS OF SATELLITE SNOW COVER IN COMPUTERIZED SHORT-TERM STREAMFLOW FORECASTING**
C. F. Leaf *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 175-186 refs Sponsored by USDA (For availability see N76-16561 07-43)
(Paper-13) CSCL 08L

A procedure is described whereby the correlation between: (1) satellite derived snow-cover depletion and (2) residual snowpack water equivalent, can be used to update computerized residual flow forecasts for the Conejos River in southern Colorado. Author

**N76-16575*** National Environmental Satellite Service, Suitland, Md.
**SIERRA NEVADA SNOW MELT FROM SMS-2**
Laurence C. Breaker (NOAA, Redwood City, Calif.) and Michael C. McMillan *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 187-197 refs (For availability see N76-16561 07-43)
(Paper-14) CSCL 08L

A film loop from SMS-2 imagery shows snow melt over the Sierra Nevadas from May 10 to July 8, 1975. The sequence indicates a successful application of geostationary satellite data for monitoring dynamic hydrologic conditions. Author

**N76-16576*** Environmental Research and Technology, Inc., Concord, Mass.
**SYNOPSIS OF CURRENT SATELLITE SNOW MAPPING TECHNIQUES, WITH EMPHASIS ON THE APPLICATION OF NEAR-INFRARED DATA**
James C. Barnes and Michael D. Smallwood *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 199-213 refs (For availability see N76-16561 07-43)
(Contract NAS9-13305)
(Paper-15) CSCL 08L

The Skylab EREP S192 Multispectral Scanner data have provided for the first time an opportunity to examine the reflectance characteristics of snowcover in several spectral bands extending from the visible into the near-infrared spectral region. The analysis of the S192 imagery and digital tape data indicates a sharp drop in reflectance of snow in the near-infrared, with snow becoming essentially nonreflective in Bands 11 (1.55-1.75 micron) and 12 (2.10-2.35 micron). Two potential applications to snow mapping of measurements in the near-infrared spectral region are possible: (1) the use of a near-infrared band in conjunction with a visible band to distinguish automatically between snow and water droplet clouds; and (2) the use of one or more near-infrared bands to detect areas of melting snow. Author

**N76-16577*** Geological Survey, Tacoma, Wash.
**COMPARISON OF DIFFERENT METHODS FOR ESTIMATING SNOWCOVER IN FORESTED, MOUNTAINOUS BASINS USING LANDSAT (ERTS) IMAGES**
M. J. Meier and W. E. Evans (Stanford Res. Inst., Menlo Park, Calif.) *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 215-234 refs (For availability see N76-16561 07-43)
(Paper-16) CSCL 08L

Snow-covered areas on LANDSAT (ERTS) images of the Santiam River basin, Oregon, and other basins in Washington were measured using several operators and methods. Seven methods were used: (1) Snowline tracing followed by measurement with planimeter, (2) mean snowline altitudes determined from many locations, (3) estimates in 2.5 x 2.5 km boxes of snow-covered area with reference to snow-free images, (4) single radiance-threshold level for entire basin, (5) radiance-threshold setting locally edited by reference to altitude contours and other images, (6) two-band color-sensitive extraction locally edited as in (5), and (7) digital (spectral) pattern recognition techniques. The seven methods are compared in regard to speed of measurement, precision, the ability to recognize snow in deep shadow or in trees, relative cost, and whether useful supplemental data are produced. Author

**N76-16578*** Zurich Univ. (Switzerland). Dept. of Geography.
**APPROACHES TO DIGITAL SNOW MAPPING WITH LANDSAT-1 DATA**
K. I. Itten *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 235-247 refs Sponsored in part by ESA (For availability see N76-16561 07-43)
(Paper-17) CSCL 08L

Applying the same LANDSAT-1 data to three substantially different image processing systems, a snow mapping task was performed. LARSYS Ver.3, STANSORT-2, and General Electric Image-100 did all the jobs of detecting the snowline in forested mountainous terrain, and to determine the snowcovered area. While the control and accuracy achieved with LARSYS is remarkable, time and effort to perform the processing favor the systems STANSORT and Image-100. The experiences and results demonstrate the need for a fast interactive system for operational snowmapping with multispectral satellite data. Author

**N76-16579*** California Univ., Davis.
**AN ALL DIGITAL APPROACH TO SNOW AREAL MAPPING AND SNOW MODELLING**
V. Ralph Algazi and Minsoo Suk *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 249-257 refs (For availability see N76-16561 07-43)
(Grant NGL-05-003-404)
(Paper-18) CSCL 08L

Remote sensing data were incorporated into a spatially distributed model of snowpack evolution. Preliminary results are presented on the estimation of primary parameters needed in such a model. Author

**N76-16580*** Maryland Univ., College Park.
**DIGITAL SNOW MAPPING TECHNIQUE USING LANDSAT DATA AND GENERAL ELECTRIC IMAGE 100 SYSTEM**
William C. Dallam (GE Co., Beltsville, Md.) and James L. Foster *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 259-278 refs (For availability see N76-16561 07-43)
(Paper-19) CSCL 08L

In this study, a technique and procedures using General Electric IMAGE 100 system were derived for performing a snow cover analysis of small watersheds for quasi-operational application. The study area was the Wind River Mountains of west central Wyoming. A small watershed, namely, Dinwoody Creek was selected as a test site. LANDSAT data and U-2 imagery were used in the analysis. From a minimal snowcover LANDSAT scene, multispectral analysis was performed yielding the distribution of forest, bare rock, grassland, water, and snow within the watershed. The forest and bare rock themes were saved and registered with other scenes containing greater snow cover. Likewise, elevation contours from a digitized map were stored and superimposed over the snowpack areas. Author

**N76-16581*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
**SNOW COVER MONITORING BY MACHINE PROCESSING OF MULTITEMPORAL LANDSAT MSS DATA**
S. G. Luther, L. A. Bartolucci, and R. M. Hoffer *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 279-294 refs (For availability see N76-16561 07-43)
(Contract NAS5-21880)
(Paper-20) CSCL 08L

LANDSAT frames were geometrically corrected and data sets from six different dates were overlaid to produce a 24 channel (six dates and four wavelength bands) data tape. Changes in the extent of the snowpack could be accurately and easily determined using a change detection technique on data which had previously been classified by the LARSYS software system. A second phase of the analysis involved determination of the relationship between spatial resolution or data sampling frequency and accuracy of measuring the area of the snowpack. Author

**N76-16582*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
**SNOWCOVER MAPPING BY MACHINE PROCESSING OF SKYLAB AND LANDSAT MSS DATA**
L. A. Bartolucci, R. M. Hoffer, and S. G. Luther *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 295-311 refs (For availability see N76-16561 07-43)
(Contract NAS9-13380)
(Paper-21) CSCL 08L

Skylab and LANDSAT MSS data were analyzed using computer-aided analysis techniques (CAAT). Results indicated that the middle infrared wavelength bands of the Skylab S-192 scanner would allow effective discrimination between snowcover and water-droplet clouds, whereas the limited spectral response of the LANDSAT-1 or 2 scanners do not allow such spectral discrimination. Five spectral classes of snowcover were defined and mapped. These classes were found to be related to differences in the proportion of snow and forest cover in the individual resolution elements. Author

**N76-16583*** National Environmental Satellite Service, Washington, D.C.
**ESTIMATING SNOW DEPTH USING VHRR DATA FROM NOAA ENVIRONMENTAL SATELLITES Progress Report**
D. F. McGinnis, Jr. *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 313-324 refs (For availability see N76-16561 07-43)
(Paper-22) CSCL 08L

The NOAA environmental satellites provide daily coverage of the earth in the visible and thermal spectral bands. The ground resolution of the very high resolution radiometer is 1 km at nadir. This improved resolution in the visible permits more detailed observations of snow features than was possible with previous operational satellites. A densitometer examination of a visible-band image from Feb. 11, 1973, which shows heavy snow cover in considerable detail over areas extending from Alabama to North Carolina, indicates that, in general, there is direct correlation between increasing brightness and increasing snow depths. A power regression analysis of greatest satellite brightness versus greatest snow depth for 201 data pairs produced a correlation coefficient of 0.86. Similar analysis of five late winter and early spring cases resulted in much lower correlations. Author

**N76-16584*** California Univ., Berkeley.
**A COMPARISON OF OPERATIONAL AND LANDSAT-AIDED SNOW WATER CONTENT ESTIMATION SYSTEMS**
James M. Sharp and Randall W. Thomas *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 325-344 refs (For availability see N76-16561 07-43)
(Grant NGL-05-003-404)
(Paper-23) CSCL 08L

How LANDSAT imagery can be cost effectively employed to augment an operational hydrologic model is described. Attention is directed toward the estimation of snow water content, a major predictor variable in the volumetric runoff forecasting model. A stratified double sampling scheme is supplemented with qualitative and quantitative analyses of existing operations to develop a comparison between the existing and satellite-aided approaches to snow water content estimation. Results show a decided advantage for the LANDSAT-aided approach. Author

**N76-16585*** Army Cold Regions Research and Engineering Lab., Hanover, N.H.
**RED AND NEAR-INFRARED SPECTRAL REFLECTANCE OF SNOW**
Harold W. OBrien and Richard H. Munis *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 345-360 refs (For availability see N76-16561 07-43)
(Paper-24) CSCL 08L

The spectral reflectance of snow in the range of 0.60 to 2.50 microns wavelengths was studied in a cold laboratory using natural snow and simulated preparations of snow. A white barium sulfate powder was used as the standard for comparison. The high reflectance (usually nearly 100%) of fresh natural snow in visible wavelengths declines rapidly at wavelengths longer than the visible, as the spectral absorption coefficients of ice increase. Aging snow becomes only somewhat less reflective than fresh snow in the visible region and usually retains a reflectance greater than 80%. In the near infrared, aging snow tends to become considerably less reflective than fresh snow. Author

**N76-16586*** National Environmental Satellite Service, Washington, D.C.
**REMOTE SENSING OF SNOWPACK DENSITY USING SHORTWAVE RADIATION**
Michael C. McMillan and James L. Smith (Pacific Southwest Forest and Range Experiment Station) *In* NASA. Goddard Space Flight Center Operational Appl. of Satellit3 Snowcover Observations 1975 p 361-373 refs (For availability see N76-16561 07-43)
(Paper-25) CSCL 08L

Albedo or satellite radiance measurements can be used to estimate average snowpack density by means of a multiple linear equation. The in situ data equation predicted density with a correlation (sq r) of 0.79 and a standard error of 0.027 gm/cu cm. The data from LANDSAT-1 were not as significant in a similar equation, possibly because of the large field of view. Author

**N76-16587*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SNOW WETNESS MEASUREMENTS FOR MELT FORECASTING**
William I. Linlor, Fred D. Clapp (California Univ., Berkeley), Mark F. Meier (Geological Survey, Tacoma, Wash.), and James L. Smith (Forest Service, Berkeley, Calif.) *In its* Operational Appl. of Satellite Snowcover Observations 1975 p 375-397 refs (For availability

see N76-16561 07-43)
(Paper-26) CSCL 08L

A microwave technique for directly measuring snow pack wetness in remote installations is described. The technique, which uses satellite telemetry for data gathering, is based on the attenuation of a microwave beam in transmission through snow. Author

**N76-16588*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MICROWAVE EMISSION FROM DRY AND WET SNOW**
T. C. Chang and P. Gloersen *In its* Operational Appl. of Satellite Snowcover Observations 1975 p 399-407 refs (For availability see N76-16561 07-43)
(Paper-27) CSCL 08L

A microscopic model was developed to study the microwave emission from snow. In this model, the individual snow particles are considered to be the scattering centers. Mie scattering theory for spherical particles is then used to compute the volume scattering and extinction coefficients of the closely packed scattering spheres, which are assumed not to interact coherently. The results of the computations show significant volume scattering effects in the microwave region which result in low observed emissivities from cold, dry snow. In the case of wet snow, the microwave emissivities are increased considerably, in agreement with earlier experimental observations in which the brightness temperatures have increased significantly at the onset of melting. Author

**N76-16589*** National Weather Service, Portland, Ore.
**APPLICATION OF BAYESIAN DECISION THEORY TO AIRBORNE GAMMA SNOW MEASUREMENT**
Vernon C. Bissell *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 409-420 refs (For availability see N76-16561 07-43)
(Paper-28) CSCL 08L

Measured values of several variables are incorporated into the calculation of snow water equivalent as measured from an aircraft by snow attenuation of terrestrial gamma radiation. Bayesian decision theory provides a snow water equivalent measurement by taking into account the uncertainties in the individual measurement variables and filtering information about the measurement variables through prior notions of what the calculated variable (water equivalent) should be. Author

**N76-16590*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SUMMARY OF THE OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS WORKING SESSION, 20 AUGUST 1975**
V. V. Salomonson and A. Rango *In its* Operational Appl. of Satellite Snowcover Observations 1975 p 421-426 (For availability see N76-16561 07-43)
(Paper-29) CSCL 08L

Various techniques for reducing the satellite data to a form usable by the operational agencies were covered in mini-presentations by the operational satellite snow interpretive personnel. Similar discussions were made by operational agency stream flow forecasters on how satellite-derived snow data could be incorporated into runoff forecasting methods. J.A.M.

**N76-16591*#** Wintek Corp., Lafayette, Ind.
**SATELLITE ON-BOARD PROCESSING FOR EARTH RESOURCES DATA Summary Report**
R. E. Bodenheimer, R. C. Gonzalez, J. N. Gupta, K. Hwang, R. W. Rochelle, J. B. Wilson, and P. A. Wintz Oct. 1975 33 p ref
(Contract NAS2-8327)
(NASA-CR-137757) Avail: NTIS HC $4.00 CSCL 05B

The feasibility was investigated of an on-board earth resources data processor launched during the 1980-1990 time frame. Projected user applications were studied to define the data formats and the information extraction algorithms that the processor must execute. Based on these constraints, and the constraints imposed by the available technology, on-board processor systems were designed and their feasibility evaluated. Conclusions and recommendations are given. Author

**N76-16592*#** Wintek Corp., Lafayette, Ind.
**SATELLITE ON-BOARD PROCESSING FOR EARTH RESOURCES DATA Final Report**
R. E. Bodenheimer, R. C. Gonzalez, J. N. Gupta, K. Hwang, R. W. Rochelle, J. B. Wilson, and P. A. Wintz Oct. 1975 199 p refs
(Contract NAS2-8327)
(NASA-CR-137758) Avail: NTIS HC $7.50 CSCL 05B

Results of a survey of earth resources user applications and their data requirements, earth resources multispectral scanner sensor technology, and preprocessing algorithms for correcting the sensor outputs and for data bulk reduction are presented along with a candidate data format. Computational requirements required to implement the data analysis algorithms are included along with a review of computer architectures and organizations. Computer architectures capable of handling the algorithm computational requirements are suggested and the environmental effects of an on-board processor discussed. By relating performance parameters to the system requirements of each of the user requirements the feasibility of on-board processing is determined for each user. A tradeoff analysis is performed to determine the sensitivity of results to each of the system parameters. Significant results and conclusions are discussed, and recommendations are presented. Author

**N76-16593*#** TRW Systems Group, Redondo Beach, Calif.
**STUDY OF ON-BOARD COMPRESSION OF EARTH RESOURCES DATA Executive Summary**
A. Habibi Sep. 1975 31 p
(Contract NAS2-8394)
(NASA-CR-137751; TRW-26566) Avail: NTIS HC $4.00 CSCL 05B

The current literature on image bandwidth compression was surveyed and those methods relevant to compression of multispectral imagery were selected. Typical satellite multispectral data was then analyzed statistically and the results used to select a smaller set of candidate bandwidth compression techniques particularly relevant to earth resources data. These were compared using both theoretical analysis and simulation, under various criteria of optimality such as mean square error (MSE), signal-to-noise ratio, classification accuracy, and computational complexity. By concatenating some of the most promising techniques, three multispectral data compression systems were synthesized which appear well suited to current and future NASA earth resources applications. The performance of these three recommended systems was then examined in detail by all of the above criteria. Finally, merits and deficiencies were summarized and a number of recommendations for future NASA activities in data compression proposed. Author

**N76-16594*#** TRW Systems Group, Redondo Beach, Calif.
**STUDY OF ON-BOARD COMPRESSION OF EARTH RESOURCES DATA Final Report**
A. Habibi Sep. 1975 224 p refs
(Contract NAS2-8394)
(NASA-CR-137752; TRW-26566) Avail: NTIS HC $7.75 CSCL 05B

For abstract, see N76-16593.

**N76-16595*#** Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
**BASIC RESEARCH AND DATA ANALYSIS FOR THE EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM AND FOR THE NATIONAL GEODETIC SATELLITE PROGRAM Semiannual Status Report, Jul. - Dec. 1975**
Jan. 1976 65 p refs
(Grants NGR-36-008-204; NGL-36-008-093; OSURF Proj. 3820-A1; OSURF Proj. 2514)
(NASA-CR-146388; SASR-15; SASR-17) Avail: NTIS HC $4.50 CSCL 08D

Data analysis and supporting research in connection with the following objectives are discussed: (1) provide a precise and accurate geometric description of the earth's surface, (2) provide a precise and accurate mathematical description of the earth's gravitational field, and (3) determine time variations of the geometry of the ocean surface, the solid earth, the gravity field and other geophysical parameters. Author

**N76-16596*#** Texas A&M Univ., College Station. Remote Sensing Center.
**GROUND TRUTH REPORT 1975 PHOENIX MICROWAVE EXPERIMENT**
Bruce J. Blanchard 21 Nov. 1975 294 p
(Contract NAS9-13904; NASA Order T-5459-C)
(NASA-CR-147427; TR-RSC-70) Avail: NTIS HC $9.25 CSCL 08M

Direct measurements of soil moisture obtained in conjunction with aircraft data flights near Phoenix, Arizona in March, 1975 are summarized. The data were collected for the Joint Soil Moisture Experiment. Author

**N76-16597*#** Wisconsin Univ., Madison. Dept. of Meteorology.
**THE EVALUATION OF A SHUTTLE BORNE LIDAR EXPERIMENT TO MEASURE THE GLOBAL DISTRIBUTION OF AEROSOLS AND THEIR EFFECT ON THE ATMOSPHERIC HEAT BUDGET Final Report**
S. T. Shipley, J. H. Joseph, J. T. Trauger, P. J. Guetter, E. W. Eloranta, J. E. Lawler, W. J. Wiscombe, A. P. Odell, F. L. Roesler, and J. A. Weinman Apr. 1975 157 p refs
(Grant NsG-1057)
(NASA-CR-146134) Avail: NTIS HC $6.75 CSCL 04A

A shuttle-borne lidar system is described, which will provide basic data about aerosol distributions for developing climatological models. Topics discussed include: (1) present knowledge of the physical characteristics of desert aerosols and the absorption characteristics of atmospheric gas, (2) radiative heating computations, and (3) general circulation models. The characteristics of a shuttle-borne radar are presented along with some laboratory studies which identify schemes that permit the implementation of a high spectral resolution lidar system. Author

**N76-16598*#** Bittinger (M. W.) and Associates, Inc., Fort Collins, Colo.
**SOIL MOISTURE GROUND TRUTH, LAFAYETTE, INDIANA, SITE; ST. CHARLES MISSOURI, SITE; CENTRALIA, MISSOURI, SITE**
E. Bruce Jones Dec. 1975 51 p
(Contract NAS5-22312)
(NASA-CR-144717) Avail: NTIS HC $4.50 CSCL 08M

The soil moisture ground-truth measurements and ground-cover descriptions taken at three soil moisture survey sites located near Lafayette, Indiana; St. Charles, Missouri; and Centralia, Missouri are given. The data were taken on November 10, 1975, in connection with airborne remote sensing missions being flown by the Environmental Research Institute of Michigan under the auspices of the National Aeronautics and Space Administration. Emphasis was placed on the soil moisture in bare fields. Soil moisture was sampled in the top 0 to 1 in. and 0 to 6 in. by means of a soil sampling push tube. These samples were then placed in plastic bags and awaited gravimetric analysis. Author

**N76-16599*#** Bonneville Power Administration, Portland, Oreg.
**AN OPERATIONAL APPLICATION OF SATELLITE SNOW COVER OBSERVATIONS, NORTHWEST UNITED STATES Final Report**
John P. Dillard Nov. 1975 32 p refs
(NASA Order S-53877)
(NASA-CR-144723) Avail: NTIS HC $4.00 CSCL 08L

LANDSAT-1 imagery showing extent of snow cover was collected and is examined for the 1973 and 1974 snowmelt seasons for three Columbia River Basins. Snowlines were mapped and the aerial snow cover was determined using satellite data. Satellite snow mapping products were compared products from conventional information sources (computer programming and aerial photography was used). Available satellite data were successfully analyzed by radiance thresholding to determine snowlines and the attendant snow-covered area. Basin outline masks, contour elevation masks, and grid overlays were utilized as satellite data interpretation aids. Verification of the LANDSAT-1 data was generally good although there were exceptions. A major problem was lack of adequate cloud-free satellite imagery of high resolution and determining snowlines in forested areas. Author

**N76-16600*#** Stanford Research Inst., Menlo Park, Calif.
**MEASURING SNOW COVER USING SATELLITE IMAGERY DURING 1973 AND 1974 MELT SEASON: NORTH SANTIAM, BOISE, AND UPPER SNAKE BASINS, PHASE 1 Final Report**
E. J. Wiegman, W. E. Evans, and R. Hadfield Jul. 1975 79 p Sponsored in part by Corps of Engineers
(NASA Order S-53442; SRI Proj. 4122)
(NASA-CR-144719) Avail: NTIS HC $5.00 CSCL 08L

Measurements are examined of snow coverage during the snow-melt season in 1973 and 1974 from LANDSAT imagery for the three Columbia River Subbasins. Satellite derived snow cover inventories for the three test basins were obtained as an alternative to inventories performed with the current operational practice of using small aircraft flights over selected snow fields. The accuracy and precision versus cost for several different interactive image analysis procedures was investigated using a display device, the Electronic Satellite Image Analysis Console. Single-band radiance thresholding was the principal technique employed in the snow detection, although this technique was supplemented by an editing procedure involving reference to hand-generated elevation contours. For each data and view measured, a binary thematic map or 'mask' depicting the snow cover was generated by a combination of objective and subjective procedures. Photographs of data analysis equipment (displays) are shown. Author

**N76-16601*#** Aeronutronic Ford Corp., Houston, Tex. Space Information Systems Operation.
**LARGE AREA CROP INVENTORY EXPERIMENT CROP ASSESSMENT SUBSYSTEM SOFTWARE REQUIREMENTS DOCUMENT**
26 Nov. 1975 102 p
(Contract NAS9-1261)
(NASA-CR-147417; USC-10009) Avail: NTIS HC $5.50 CSCL 09B

The functional data processing requirements are described for the Crop Assessment Subsystem of the Large Area Crop Inventory Experiment. These requirements are used as a guide for software development and implementation. Author

**N76-16602*#** Avco-Everett Research Lab., Everett, Mass.
**AIRBORNE OCEANOGRAPHIC LIDAR SYSTEM Final Report**
Oct. 1975 150 p refs
(Contract NAS6-2653)
(NASA-CR-141407) Avail: NTIS HC $6.00 CSCL 20E

Specifications and preliminary design of an Airborne Oceanographic Lidar (AOL) system, which is to be constructed for installation and used on a NASA Wallops Flight Center (WFC) C-54 research aircraft, are reported. The AOL system is to provide an airborne facility for use by various government agencies to demonstrate the utility and practicality of hardware of this type in the wide area collection of oceanographic data on an operational basis. System measurement and performance requirements are presented, followed by a description of the conceptual system approach and the considerations attendant to its development. System performance calculations are addressed, and the system specifications and preliminary design are presented and discussed. Author

**N76-16603#** Royal Netherlands Meteorological Inst., De Bilt.
**AN APPROACH TO THE POSSIBILITIES OF FORECASTING DOWNY MILDEW INFECTION IN ONION CROPS**
G. A. deWeille 1975 85 p refs
(KNMI-102-97) Avail: NTIS HC $5.00; Roy. Neth. Meteorol. Inst. Dfl. 17.50

Peronospera destructor, a weather dependent fungus, inflicts considerable damage on onion crops and can only be controlled by preventive insecticide application. A forecast system being desirable, a tentative bioclimatological model was developed consisting of a series of consecutive (micro) climatic conditions to be met for the crop to become appreciably infected, and field trials were carried out. Consequently, a definitive model was set up. This was tested in the research period from 1960 to 1965 listing all potential infection dates. A study of weather-map situations reveals that only a few synoptic situations lead to fulfillment of basic infection criteria. Integrated disease control

is proposed applying also biological thresholds with a view to establishing warning dates. Author (ESA)

**N76-16604*#** Geological Survey, Tallahassee, Fla. Water Resources Div.
**SATELLITE RELAY AND PROCESSING OF HYDROLOGIC DATA IN SOUTH FLORIDA Final Report Water-Resources Investigations**
E. J. Wimberly Jul. 1975 21 p refs
(NASA-CR-146092; PB-244784/5; USGS/WRI-12-75; USGS/WRD-75/050) Avail: NTIS HC $3.50 CSCL 13B

Management of water in south Florida requires current hydrologic data on water levels and rainfall. This need is being met by a data processing system which provides near-real-time data from remote areas. The flow of data is from data-collection platforms at field sites via LANDSAT-1 satellite to the National Aeronautics and Space Administration's (NASA) ground-receiving stations to the NASA Data Processing Facility at Goddard Space Flight Center to the Miami office of the U. S. Geological Survey to data users. The process requires only a few hours, and current data are provided to water-management agencies in several different forms. The system has proven to be dependable. GRA

**N76-16605#** Alaska Univ., College. Geophysical Inst.
**MAJOR LATE-WINTER FEATURES OF ICE IN NORTHERN BERING AND CHUKCHI SEAS AS DETERMINED FROM SATELLITE IMAGERY**
Lewis H. Shapiro and John J. Burns Jun. 1975 22 p Presented at the Ann. Am. Geophys. Union Fall Meeting, San Francisco, 12-17 Dec. 1974 Prepared in cooperation with Alaska Dept. of Fish and Game
(Grant NOAA-02-3-158-41)
(COM-75-11343/1; UAG-R-236; Alaska-Sea-Grant-Pub-75-8; NOAA-75090412) Avail: NTIS HC $3.50 CSCL 08J

Imagery from the ERTS-1, DAPP, and NOAA 2/3 VHRR satellite systems were used for identification of recurring features of the movement and distribution of sea ice in the Bering and Chukchi seas during late winter. The pattern observed is consistent with a general southward drift of sea ice under the influence of the prevailing northerly winds present in the area during this time of year. GRA

**N76-16606#** Georgia Marine Science Center, Savannah.
**OCEANOGRAPHIC OBSERVATIONS IN THE GEORGIA BIGHT: DATA REPORT FOR R.V. EASTWARD CRUISES E-13-73 (4-11 SEPTEMBER) AND E-19-73 (8-9 DECEMBER 1973)**
Larry P. Atkinson 1975 162 p refs Sponsored in part by ONR
(Grants NSF GA-27725; NSF GX-33615; NSF GX-39141; EPA-R-800372)
(COM-75-11324/1; TR-75-6) Avail: NTIS HC $6.75 CSCL 08J

Data from Cruise E-13-73 (4-11 September 1973) and Cruise E-19-73 (8-9 December 1973) of the R.V. EASTWARD in the Georgia Bight are presented. Included are the NODC station printouts with the following data: depth, temperature, salinity, oxygen, phosphate, nitrate, silicate, dissolved organic, phosphate, nitrate, silicate, dissolved organic carbon, weather, ships' position, station time, and depth. Biological data include: chlorophyll, carbon-14 primary productivity, particulate carbon and nitrogen, principal zooplankton species, and main benthic marco-invertebrates. Sediment size analysis and mercury analysis are also included. GRA

**N76-16607#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
**REMOTE SENSING STUDIES IN THE NEW YORK BIGHT Final Report**
C. T. Wezernak, D. R. Lyzenga, and F. C. Polcyn Jul. 1975 75 p refs
(COM-75-11358/9; ERIM-109300-5-F; NOAA-75082104) Avail: NTIS HC $4.50 CSCL 08J

The results are described of a remote sensing program of data collection and analysis undertaken in the New York Bight. Aircraft multispectral missions were carried out on 7 April 1973. The morning mission on that date coincided with the ERTS-1 satellite pass over the area. The principal objectives of the program were to provide data, which when combined with shipboard measurements, would describe the surface waters of the area and their general circulation. Specifically the remote sensing program was designed to provide the following information: (1) sea surface temperature distribution, (2) surface chlorophyll concentrations, (3) secchi disc transparency, (4) document ocean dumping practices, and (5) movement of water masses as evidenced by dye tracer materials. GRA

**N76-16608#** Bausch and Lomb, Inc., Rochester, N.Y.
**PAVE STRIKE ANALYSIS. 1: INVESTIGATION OF A POINT TRANSFER DEVICE Final Technical Report**
Walter R. Ambrose Griffiss AFB, N.Y. RADC Jun. 1975 57 p
(Contract F30602-74-C-0286; AF Proj. 2106)
(AD-A015067; RADC-TR-75-151) Avail: NTIS CSCL 08/2

This effort investigated the requirements for a point transfer device to support the Manual Photogrammetric Targeting System (PTS-M). The purpose of the point transfer device is to correlate a tactical image with a data base image and to make a physical mark on the data base image which precisely locates a target observed on the tactical image. This report defines the factors affecting the design of the instrument, itemizes the design specifications, surveys possible off-the-shelf equipment and suggests an instrument which can meet the requirements. The indicated design will allow an operator to view a tactical image and a data base image in superposition. The operator can change the scale, stretch, direction of stretch, rotation and translation of both images until they are precisely registered. The operator aligns a reticle with the target, activates a marker and makes a mark on the data base which corresponds to the position of the target. A capacitive discharge system is used in the marking. A study was made to compare the repeatability of various viewing modes but the results were inconclusive and further experimentation was recommended. GRA

**N76-16609#** Federal Energy Administration, Washington, D.C. Office of Coal.
**PROJECT PROPOSAL FOR SURFACE-MINED LAND ENHANCEMENT (SMILE)**
Arthur M. Hughes and David R. Maneval (Appalachian Regional Comm.) 29 Jan. 1975 71 p refs
(PB-245567/3; FEA/G-75/586) Avail: NTIS HC $4.50 CSCL 08I

A program is outlined to reclaim 6,000 acres of the worst strip-mined land on public property in 5 states: Pennsylvania, Ohio, Maryland, Kentucky, and Alabama. The five basic goals of the project are: restore public lands which have been surface mined; demonstrate that surface-mined land can be restored in ways that preserve or enhance the environment; provide immediate employment; improve secondary employment opportunities and long-term economic prospects of reclaimed areas through construction of such land-utilization features as public forests, grazing lands, farm lands, parks, recreation and tourism opportunities; make possible improvements in national coal production. GRA

**N76-16610#** Barry (Theodore) and Associates, Los Angeles, Calif.
**OPERATIONS STUDY OF SELECTED SURFACE COAL MINING SYSTEMS IN THE UNITED STATES Final Open File Report**
Feb. 1975 236 p
(Contract BM-So-141048)
(PB-245085/6; BM-OFR-72-75) Avail: NTIS HC $8.00 CSCL 08I

Selected surface coal mining systems in the United States are discussed. The potential production and economic capacity of the systems is assessed. One mine was selected from each of the major coal fields: midwestern, eastern, northwestern, and southwestern. Following the documentation of each operation and development of a comprehensive production and cost data base, an analysis was conducted to identify production inefficiencies and to develop short-term and long-term improvements that would increase the mines' productivity or reduce costs. GRA

**N76-16611#** Bureau of Mines, Dallas, Tex. Mineral Supply Field Office.
**SULFUR CONTENT OF CRUDE OILS**
M. Carrales, Jr. and R. W. Martin Aug. 1975 66 p refs (PB-245192/0; BM-IC-8676) Avail: NTIS HC $4.50 CSCL 21D

Information is presented pertaining to the sulfur content of crude oil produced during 1971 in the United States and in some foreign countries. These data are presented for fields in 26 States that accounted for about 76 percent of the U.S. oil production during 1971 and for fields in 24 foreign countries that accounted for about 64 percent of the total oil produced from these countries during the same year. The tabular data include the following items: geographical area or foreign country, field name, sulfur content, analysis number, geologic formation, geologic age, depth of formation, and 1971 oil production. Summary tables show the classification of U.S. and foreign crude oil production during 1971 by sulfur content. The objective was to classify the 1971 crude oil production from U.S. and foreign fields, where crude oil analyses were available, according to sulfur content. GRA

**N76-16363** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
**EFFECTS OF VARYING REYNOLDS NUMBER AND BOUNDARY LAYER DISPLACEMENT THICKNESS ON THE EXTERNAL FLOW OVER NOZZLE BOATTAILS**
D. Zonars, James A. Laughrey, and Douglas L. Bowers *In* AGARD Improved Nozzle Testing Tech. in Transonic Flow Oct. 1975 28 p refs (For availability see N76-16357 07-34)

## 44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

**N76-16612*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THERMOELECTRIC POWER SYSTEM Patent**
Ambrose W. Byrd, inventor (to NASA) Issued 6 Jan. 1976 5 p Filed 19 Mar. 1974 Supersedes N74-18726 (12 - 10, p 1128)
(NASA-Case-MFS-22002-1; US-Patent-3,931,532; US-Patent-Appl-SN-452769; US-Patent-Class-310-4; US-Patent-Class-136-202; US-Patent-Class-136-210; US-Patent-Class-165-105) Avail: US Patent Office CSCL 10A

A thermoelectric power system is described which is particularly adaptable for use in outer space. A nuclear reactor heats a working fluid, which in turn supplies heat to a plurality of thermoelectric generators spaced about a ring-shaped support. A first heat pipe is employed to couple heat between the hot fluid and hot junction of the thermoelectric element of each generator, and a second heat pipe couples heat away from the cold junction of each thermoelectric element. Each of the second heat pipes are elongated flexible units adapted to be folded upon launch and thereafter extended in space to provide a substantial area for the radiation of heat to be discharged.
Official Gazette of the U.S. Patent Office

**N76-16613** Washington State Univ., Pullman.
**POWER SYSTEM PROTECTION WITH DIGITAL COMPUTERS Ph.D. Thesis**
Ajay Kumat Sood 1975 292 p
Avail: Univ. Microfilms Order No. 76-329

A digital computer program for the protection of a substation is described. The substation has three three-phase transmission lines emanating from it. The program provides percentage differential protection against bus faults and coordinated three-zone phase and ground distance protection against transmission line faults. The program detects the presence of a disturbance, classifies the disturbance into one of six fault types and one of four fault zones. Using a method of impedance calculation, the apparent resistance and reactance of the faulted line are calculated. The computed values of impedance are compared against three-zone trapezoidal distance characteristics. Depending on the location of fault, circuit breaker tripping is initiated. Once a disturbance is detected, all the fault zones are tested for all types of faults before returning control to the normal mode. The accuracy of calculation and reliability of detection are determined from fault data for a model power system. Dissert. Abstr.

**N76-16614** Purdue Univ., Lafayette, Ind.
**ANALYSIS AND SIMULATION OF POWER TRANSMISSION LINES BY FREQUENCY RESPONSE Ph.D. Thesis**
David Morris Triezenberg 1975 130 p
Avail: Univ. Microfilms Order No. 76-599

Approximate methods of transmission line modeling are investigated. Distortion effects due to imperfect conductors, imperfect earth, and the absence of shunt conductance are considered throughout. The adequacy of the approximate models is judged by frequency response criteria. Dissert. Abstr.

**N76-16615** Iowa State Univ. of Science and Technology, Ames.
**US ELECTRICAL ENERGY DILEMMA AND AN ENERGY MODEL FOR THE ELECTRICAL UTILITIES OF IOWA Ph.D. Thesis**
Turan Gonen 1975 336 p
Avail: Univ. Microfilms Order No. 76-1841

Energy sources were examined; energy supply and demand were projected to the year 2000; various U.S. energy forecasts were compared; and some energy related issues were discussed in relation to these forecasts. A computerized electric energy cost model was developed for the electric power industry to minimize the cost of energy used for electric generation by optimum allocation of various fuel-mixes over a period of n years, where the energy is subject to a large number of physical and environmental constraints. The results showed that the computerized model is a promising tool in long range power systems planning. It was demonstrated that there can be considerable savings to the companies and to the consumer, if the companies act as a united group to meet their customers' electrical energy demand in an optimum fashion. Dissert. Abstr.

**N76-16616** Purdue Univ., Lafayette, Ind.
**STOCHASTIC LOAD MODELING AND OPTIMAL DYNAMIC GENERATION CONTROL IN POWER SYSTEMS Ph.D. Thesis**
Ali Keyhani 1975 209 p
Avail: Univ. Microfilms Order No. 76-550

Problems encountered in the operation of the boilers in electric power plants, which occur due to the maintenance of maximum throttle pressure, include large fluctuations in turbine metal temperatures and throttling losses. It is suggested that these problems be overcome by allowing boilers to operate in a variable pressure mode. The boiler pressure would be allowed to vary as function of load. One-step-ahead load demand of the system would be forecasted by means of stochastic load modeling, and the target pressure calculated from the target MW load demand. Under this new setting, the target MW levels would still be determined by equal incremental cost theory. However, the MW output of each boiler would be guided toward its assigned economic target level at a rate which ensures the minimization of the chosen cost functional (fuel cost). This is to be accomplished by means of constant valve setting. Dissert. Abstr.

**N76-16617** Kansas Univ., Lawrence.
**WIND/SOLAR ENERGY INVESTIGATION, A FEASIBILITY STUDY Ph.D. Thesis**
George Hazen Stickney 1975 489 p
Avail: Univ. Microfilms Order No. 76-1311

The question of utilizing the wind and sun to provide the energy required by an average home for space heating, air conditioning, and a hot water supply was considered. Energy requirements were compared with the daily availability of wind

and solar energy and the storage needed to reconcile the two was determined. Preliminary design procedures are shown for wind and solar energy collection and systems storage. Initial design procedures are also shown for an accompanying heating and cooling system. Although wind and solar energy are free, non-depleting and non-polluting, the high initial cost of the required hardware causes them to be economically noncompetitive with more conventional fuels. Specifically, this system was estimated to have an annual cost in 1975 of around 2 1/2 times that of a home heated by natural gas and about 13 percent higher than an all electric home. However, this cost was estimated to drop by at least one third by 1985. Dissert. Abstr.

**N76-16618#** National Aeronautical Establishment, Ottawa (Ontario).
**AERODYNAMIC PERFORMANCE THEORY FOR THE NRC VERTICAL-AXIS WIND TURBINE**
R. J. Templin Jun. 1974 38 p refs
(LTR-LA-160) Avail: NTIS HC $4.00

A theory suitable for digital computation was developed that accounts for the main features of the performance of the NRC vertical axis wind turbine. The theory takes into account the curved blade shape and the effects of airfoil stalling on performance. A comparison is made between theoretical and experimental power coefficient and rotor drag coefficient. Numerical results are presented to show the theoretical effects of geometric variables such as blade solidity and rotor height-diameter ratio, and of variations in aerofoil aerodynamic characteristics. Author

**N76-16619*#** Raytheon Co., Waltham, Mass. Microwave Tube Operation.
**FREE-SPACE MICROWAVE POWER TRANSMISSION STUDY, PHASE 3 Final Report, 9 Dec. 1969 - 31 Jul. 1974**
W. C. Brown 10 Sep. 1975 130 p refs
(Contract NAS8-25374)
(NASA-CR-144151; Pt-4601) Avail: NTIS HC $6.00 CSCL 10B

The results of an investigation of the technology of free-space power transmission by microwave beam are presented. A description of the steps that were taken to increase the overall dc to dc efficiency of microwave power transmission from 15 percent to over 50 percent is given. Included in this overall efficiency were the efficiencies of the dc to microwave conversion, the microwave transmission itself, and the microwave to dc conversion. Improvements in launching the microwave beam with high efficiency by means of a dual mode horn resulted in 95 percent of the output of the microwave generator reaching the receiving area. Emphasis was placed upon successive improvements in reception and rectification of the microwave power, resulting in the design of a rectenna device for this purpose whose efficiency was 75 percent. The procedures and the hardware developed were the basis for tests certified by the Jet Propulsion Laboratory in which an overall dc to dc efficiency of 54 percent was achieved. Author

**N76-16620*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: PROTOTYPE MODERATELY CONCENTRATING GROOVED COLLECTORS**
Jan. 1976 13 p refs
(NASA-TM-X-71863; E-8626) Avail: NTIS HC $3.50 CSCL 10A

Prototypes of moderately concentrating grooved collectors were tested with a solar simulator for varying inlet temperature, flux level, and incident angle. Collector performance is correlated in terms of inlet temperature and flux level. Author

**N76-16621*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**PYROLYSIS SYSTEM AND PROCESS Patent Application**
Shang-I. Cheng, inventor (to NASA) (Cooper Union) Filed 30 Dec. 1975 16 p Sponsored by NASA
(NASA-Case-MSC-12669-1; US-Patent-Appl-SN-645503) Avail: NTIS HC $3.50 CSCL 10B

A pyrolysis system and process for recovering energy from solid waste and other feedstocks containing hydrocarbons such as coal, asphalt, naphtha, cheap crude oils, etc. is described. The process is comprised of the following steps: continuously feeding the feedstock into a pyrolyzer for pyrolysis and gasification; continuously circulating a hot heat transfer agent through the pyrolyzer for promoting pyrolysis and gasification by direct contact with the feedstock; and removing the pyrolysis gases from the pyrolyzer for further energy treatment and use. NASA

**N76-16622*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LABORATORY 15 kV HIGH VOLTAGE SOLAR ARRAY FACILITY**
Joseph C. Kolecki and Suzanne T. Gooder Jan. 1976 29 p refs
(NASA-TM-X-71860; E-8619) Avail: NTIS HC $4.00 CSCL 10A

The laboratory high voltage solar array facility is a photoelectric power generating system. Consisting of nine modules with over 23,000 solar cells, the facility is capable of delivering more than a kilowatt of power. The physical and electrical characteristics of the facility are described. Author

**N76-16623*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STANDARIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: A STEEL FLAT-PLATE COLLECTOR WITH TWO TRANSPARENT COVERS AND A PROPRIETARY COATING**
Jan. 1976 7 p ref
(NASA-TM-X-71869) Avail: NTIS HC $3.50 CSCL 10A

Basic test results of a flat-plate solar collector whose performance was determined in the NASA-Lewis solar simulator are given. The collector was tested over ranges of inlet temperature and flux level. Author

**N76-16624*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STANDARD PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: A SELECTIVELY COATED, FLAT-PLATE COPPER COLLECTOR WITH ONE TRANSPARENT COVER AND A TUBE-TO-TUBE SPACING OF 3-7/8 INCHES**
Jan. 1976 7 p ref
(NASA-TM-X-71868) Avail: NTIS HC $3.50 CSCL 10A

Basic test results are given of a flat-plate solar collector whose performance was determined in the NASA-Lewis solar simulator. The collector was tested over ranges of inlet temperatures, fluxes, and coolant flow rates. Collector efficiency is correlated in terms of inlet temperature and flux level. Author

**N76-16625#** Committee on International Relations (U.S. House).
**US INTERNATIONAL ENERGY POLICY**
Washington GPO 1975 193 p refs Hearing before Subcomm. on Intern. Resources, Food, and Energy of Comm. on Intern. Relations, 94th Congr., 1st Sess., 1 May 1975
(GPO-53-813) Avail: Subcomm. on Intern. Resources, Food, and Energy

The direction of the U. S. International energy policy is discussed in the aftermath of the failure of the preliminary conference in Paris to produce agreement among oil consuming countries, oil producing countries, and non-oil-producing countries on the agenda for a major internaional conference. The issues discussed at the conference, the International Energy Agency and its viability, and related legislation are considered. J.M.S.

**N76-16626#** Committee on Interstate and Foreign Commerce (U. S. House).
**BASIC ENERGY DATA AND GLOSSARY OF TERMS**
Washington GPO Jun. 1975 225 p refs Rept. by Comm. on Interstate and Foreign Commerce, 94th Congr., 1st Sess., Jun. 1975
(GPO-53-220) Avail: US Capitol, House Document Room

Statistics concerning energy production and consumption are presented. Data are included for energy sources, electric utilities, nuclear power, energy consumption, resource development, prices, and basic resources for the U.S. and the world. F.O.S.

**N76-16627#** Joint Committe on Atomic Energy (U. S. Congress).
**AUTHORIZING APPROPRIATIONS FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION FOR FISCAL YEAR 1976 AND FOR THE TRANSITION QUARTERLY ENDING 30 SEPTEMBER, 1976**
Washington GPO 1975 58 p Rept. to accompany S. 598, 94th Congr., 1st Sess., 21 Apr. 1975
(S-Rept-94-104; GPO-38-006) Avail: US Capitol, Senate Document Room

The fiscal budget is outlined for the following: (1) fission power reactor development and safety engineering; (2) space nuclear systems; (3) development of isotopes; (4) weapons development; (5) solar and other energy sources; and (6) research facilities. Total operating expenses, plant and capital equipment are discussed and compared to budgets of previous years. J.R.T.

**N76-16628#** Committee on Government Operations (U. S. House).
**FEDERAL INVOLVEMENT IN THE DEVELOPMENT OF EASTERN OIL AND GAS SHALE**
Washington GPO 1975 65 p Hearings before a subcomm. of Comm. on Govt. Operations, 94th Congr., 1st Sess., 8 May 1975
(GPO-54-728) Avail: Comm. on Govt. Operations.

Testimony is provided on development of the eastern oil shale which extends from Texas through the Middle West and East into western New York State. The nonpolluting nature of the energy sources and the advanced technology needed to develop it are discussed. J.M.S.

**N76-16629#** AEG-Telefunken, Wedel (West Germany).
**DEVELOPMENT OF LARGE AREA THIN SILICON SOLAR CELLS [ENTWICKLUNG GROSSFLAECHIGER DUENNER SILIZIUM-SOLARZELLEN]**
Horst Fischer, Willi Pschunder, and Wolfgang Bogner Bonn Bundesmin. fuer Forsch. und Technol. Sep. 1975 121 p refs In GERMAN; ENGLISH summary
(Contracts BMFT-RFT-3070; GfW-RV-11-07-8/70-Z)
(BMFT-FB-W-75-14) Avail: NTIS HC $5.50; ZLDI, Munich DM 25,45

Economic processes for fabricating large area, thin silicon solar cells were developed. The influence of various methods on the electrical and mechanical properties was thoroghly investigated. For specific applications, such as flexible solar generators, new contact geometries were innovated. A simple solution is presented for the fabrication of a p plus backside contact. Electrical data and environmental test data of large area cells per unit area were comparable to those of standard cells. Cells measuring 2 x 4 cm with approximately 200 micrometer thickness seem to be the most economical ones. Author (ESA)

**N76-16630#** Portland Cement Association, Skokie, Ill.
**ENERGY CONSERVATION POTENTIAL IN THE CEMENT INDUSTRY**
Jun. 1975 344 p refs
(Contract DI-14-01-0001-1858)
(PB-245159/9; FEA/D-75/400) Avail: NTIS HC $10.00 CSCL 10A

Detailed background data are given which are needed to establish energy conservation objectives which are reasonable for the industry, to assess the potential for energy conservation within the industry, and to establish the probable impacts of certain levels and types of federal research, development, and demonstration support. It discusses basic materials, processes used in manufacturing, new technology available, and the controlling economics. GRA

**N76-16631#** Ohio State Univ., Columbus. Engineering Experiment Station.
**THERMAL RESPONSE AND MODEL OF HEATING AND COOLING EQUIPMENT FOR RESIDENTIAL HOMES**
C. F. Sepsy, J. M. Salvadore, and M. F. McBride Jun. 1975 82 p refs Sponsored by Electric Power Research Inst.
(PB-244991/6; EPRI-137-2) Avail: NTIS HC $5.00 CSCL 10A

A mathematical model was constructed which can simulate the building thermal load and energy consumption component of a two-story residential dwelling. A floating temperature analysis plus load profile calculation and system simulation is given. GRA

**N76-16632#** Office of Telecommunications, Washington, D.C.
**BIBLIOGRAPHY OF SELECTED ABSTRACTS OF DOCUMENTS RELATED TO ENERGY CONSERVATION THROUGH TELECOMMUNICATIONS**
Charles E. Lathey and Joseph R. Bewick Aug. 1975 77 p
(COM-75-11367/0; OT-SP-75-5) Avail: NTIS HC $5.00 CSCL 10A

A collection of documents related to the use of telecommunications as a potential for conserving energy is given. Each document is abstracted, authors are listed, date of publication, and information provided that will give the reader necessary information to obtain the document if desired. GRA

**N76-16633#** Metropolitan Washington Council of Governments, D.C.
**ENERGY INFORMATION RESOURCES MAINTAINED BY THE METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS Final Report**
T. Markle, R. Haas, and M. Fraser May 1975 85 p
(PB-245248/0) Avail: NTIS HC $5.00 CSCL 05B

The current capability is described of Council of Government's Metropolitan Energy Information Center. Approximately 500 documents are listed by major subject codes. Unit operations performed on materials received by the Center are described, and the Center's public access procedures and operations philosophy are reviewed. GRA

**N76-16634#** Ohio State Univ., Columbus. Engineering Experiment Station.
**HEAT TRANSFER MODELS AND ENERGY NEEDS FOR RESIDENTIAL HOMES**
C. F. Sepsy, R. S. Blancett, and M. F. McBride Jun. 1975 116 p refs
(PB-244992/4; EPRI-137-3) Avail: NTIS HC $5.50 CSCL 10A

The results of the development and field validation of algorithms to simulate heating and cooling loads and energy requirements for a split-level and a ranch-style test house are discussed. The report includes: (1) a description of the test sites, (2) a description of the instrumentation and data acquisition system used to collect data at the test sites, (3) a discussion of the algorithms developed and used to determine heating and cooling loads and energy requirements, and (4) comparisons of simulated versus measured test site space temperatures and cooling energy requirements. GRA

**N76-16635#** North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
**RESEARCH ON SOLAR ENERGY STORAGE SUBSYSTEMS UTILIZING THE LATENT HEAT OF PHASE CHANGE OF PARAFFIN HYDROCARBONS FOR THE HEATING AND COOLING OF BUILDINGS Semiannual Report**
J. A. Bailey, J. C. Mulligan, C. K. Liao, and S. I. Guceri 1975 75 p refs Sponsored by NSF
(PB-244872/8; NSF/RA/N-75-075) Avail: NTIS HC $4.50 CSCL 13A

An analytical and experimental research program designed to assess the potential of a solar energy storage subsystem (thermal capacitor) using the latent heat of fusion of paraffin hydrocarbons for the heating and cooling of buildings, is described. An idealized model of a flat plate thermal capacitor based on uniaxial heat conduction with a change of phase and an absence of natural convection in the phase change material is assumed. An analysis of the model using the asymptotic expansion and Goodman techniques for the melting (freezing) process is conducted. The analyses are used to generate data concerning the variation with time of the capacitor fluid outlet temperature and internal temperature distribution for various capacitor inlet temperatures, mass flow rates, latent heats of fusion, effective thermal conductivities and capacitor sizes. An experimental system consisting of a prototype thermal capacitor, fluid flow control unit, and hydraulic system for the generation of performance data is described. GRA

**N76-16636#** Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
**SOLAR HEATING PROOF-OF-CONCEPT EXPERIMENT FOR A PUBLIC SCHOOL BUILDING Final Report**

6 Nov. 1974 89 p refs
(Contract NSF C-870)
(PB-245008/8; Rept-41434-FR; NSF/RA/N-74-119) Avail: NTIS HC $5.00 CSCL 13A

A 5000-square-foot solar energy system to supplement the heating and hot water requirements of North View Junior High School in suburban Minneapolis is discussed. The report discusses in detail the collector design, system design, system operation, and system performance. GRA

**N76-16637#** Boeing Co., Seattle, Wash. Engineering and Construction Div.
**GLASS SOLAR HEAT COLLECTOR DEVELOPMENT Progress Report, 1 Nov. - 30 Apr. 1975**
W. D. Beverly and R. B. Gillette May 1975 102 p refs
(Grant NSF AER-74-09139)
(PB-245019/5; NSF/RA/N-75-060) Avail: NTIS HC $5.50 CSCL 13A

An all-glass-vacuum-insulated solar heat collector for heating and cooling of buildings was investigated. The major tasks accomplished during the first six months include: (1) construction and testing of a prototype collector; (2) development of a test facility to accurately measure the performance of the collector designs; (3) completion of the major portion of thermal analyses; (4) investigation into the types of blackening agents available and their behavior under conditions expected in collector operations; (5) development of facilities to test adhesives for the bonded collector design; (6) completion of preliminary applications studies aimed at incorporating collectors into standard building construction; and (7) discussion with glass manufacturers to obtain technical, manufacturing, and cost information on glass. GRA

**N76-16638#** Union Carbide Corp., Tonawanda, N.Y. Linde Div.
**LIQUID HELIUM REFRIGERATOR FOR TESTING SUPERCONDUCTING SYSTEM Final Report**
H. Morihara and J. W. Terbot Aug. 1975 41 p Sponsored by Electric Power Research Inst.
(PB-244666/4; EPRI-7839) Avail: NTIS HC $4.00 CSCL 13A

In the next several years, various superconducting test transmission cables will probably be built and tested. Each test cable will require a medium sized helium refrigerator. To avoid unnecessary duplication of refrigeration systems required for testing, the development of a central cryogenic test facility is being considered. Such a facility would have a high capacity helium test refrigerator which would be capable of simultaneously supplying the needs of all test cables and the additional needs of at least two superconducting test generators. This study presents a detailed quantitative analysis of the refrigerator options available with consideration given to reliability, operating flexibility, capital costs and operating expenses. GRA

**N76-16639#** National Bureau of Standards, Boulder, Colo. Cryogenics Div.
**FEASIBILITY STUDY OF A MULTIPURPOSE REFRIGERATOR FOR A SUPERCONDUCTING CABLE TEST FACILITY Final Report**
T. R. Strobridge Jul. 1975 52 p refs Sponsored by Electric Power Research Inst.
(PB-244630/0; EPRI-282-FR) Avail: NTIS HC $4.50 CSCL 13A

A major problem in simultaneously cooling a number of test sections of super-conducting power transmission cables is the wide variation in cable operating pressures and temperatures. It is feasible to couple a single large refrigerator to the cables with individual pumped helium circulation circuits. The system is flexible in both pressure and temperature and in the temperature rise along the length of the cable. The total refrigeration capacity required for a test facility is derived from current estimates of cable characteristics. A single refrigerator is shown to be less expensive than individual refrigerators for each cable even when the penalties for pump work and heat transfer through large temperature differences are included. GRA

**N76-16640#** Houston Univ., Tex. Dept. of Mechanical Engineering.
**THE EVALUATION OF SURFACE GEOMETRY MODIFICATION TO IMPROVE THE DIRECTIONAL SELECTIVITY OF SOLAR ENERGY COLLECTORS Semiannual Progress Report, 1 Jan. - 30 Jun. 1975**
John R. Howell 31 Jul. 1975 44 p refs
(Grant NSF AER-73-03357)
(PB-245188/8; UHME/Sol/8;
NSF/AER-73-03357/A01-PR/75/2; NSF/RA/N-75-081) Avail: NTIS HC $4.00 CSCL 13A

Moderately concentrating collectors composed of parallel, east-west oriented, stationary, trapezoidal grooves are examined. Computer simulations of radiative behavior with direct beam, nondirect, and various combinations of insolation are presented. GRA

**N76-16641#** Colorado Univ., Boulder.
**DEMAND ANALYSIS SOLAR HEATING AND COOLING OF BUILDINGS, PHASE 1. REPORT. SOLAR WATER HEATING IN SOUTH FLORIDA, 1923 - 1974**
Jerome E. Scott, Ronald W. Melicher, and Donald M. Sciglimpaglia Dec. 1974 179 p refs
(Grant NSF GI-42508)
(PB-245322/3; NSF/RA/N-74-190) Avail: NTIS HC $7.50 CSCL 13A

Two specific areas of research are discussed. The first is an assessment of the solar water heater industry in South Florida. This section documents the historical development of the industry and provides an analysis of its future potential. The second investigates the attitudes and expectations of important lending institutions toward the use of solar energy for space heating and cooling of single family residences. GRA

**N76-16642#** Delaware Valley Regional Planning Commission, Philadelphia, Pa.
**POTENTIAL FOR CONVERSION TO COAL AS A FUEL BY MAJOR FUEL USERS IN THE PENNSYLVANIA COUNTIES OF BUCKS, CHESTER, DELAWARE, MONTGOMERY AND PHILADELPHIA Final Report**
Charles R. Roxin and Michael Tinkleman Dec. 1974 71 p refs
(Grant HUD-CPA-PA-1054)
(PB-244946/0; DVRPC-74-14; TR-15) Avail: NTIS HC $4.50 CSCL 21D

Major fuel users in the Pennsylvania counties of Bucks, Chester, Delaware, Montgomery and Philadelphia are identified. Their present fuel use is discussed and the potential for their conversion from oil and gas to coal as fuel is briefly assessed. Impacts on air quality and freight rail needs are also reviewed. Finally, the attitudes of these industries toward conversion is discussed, particularly in reference to local reaction to national issues and policies. GRA

**N76-16643#** Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
**CONTINUOUS SILICON SOLAR CELLS Annual Progress Report, 1 Oct. - 31 Dec. 1973**
B. Chalmers, T. Surek, A. I. Mlavsky, D. N. Jewett, and J. C. Swartz Jan. 1974 108 p refs
(Grant NSF GI-37067)
(PB-245007/0; NSF/RANN/SE/GI-37067X/PR/73/4;
NSF/RA/N-74-010) Avail: NTIS HC $5.50 CSCL 10B

Research is described on the application of the edge-defined, film fed growth (EFG) crystal growth technique to the continuous growth of single crystal silicon ribbons from the melt. A detailed theoretical treatment of the problem of edge-definition, i.e. the relationship of the crystal geometry to the system and the growth parameters, is presented. The theoretical analyses are used in the design of the various system components and in the establishment of acceptable growth conditions. An analysis of the die material pans of using partially wetting dies of quartz, and in controlling the thermal environment for systems using carbon dies are described. The results of ribbon growth experiments and of solar cell fabrications are presented. GRA

**N76-16644#** Naval Weapons Center, China Lake, Calif.
**A PROGRAM TO EVALUATE AND DEMONSTRATE CONSERVATION OF FOSSIL FUEL ENERGY FOR SINGLE-FAMILY DWELLINGS**

Jun. 1975 75 p Sponsored by FEA
(PB-245064/1; FEA/D-75/529) Avail: NTIS HC $4.50 CSCL 13A

A program is outlined which will demonstrate reduction in the United States fossil-fuel energy usage, particularly residential, shopping, and commuting. Goals include combining more efficient energy use with low-energy structures to demonstrate that fuel consumption in single-family dwellings can be cut at least in half, reducing fuel consumption further, and where solar flux is adequate, replacing use of fossil fuels in the single-family home with high temperature solar energy and demonstrating a solar-powered, thermal-storage car for short trips. GRA

**N76-16645#** Bechtel Corp., San Francisco, Calif.
**ELECTRIC POWER GENERATION USING GEOTHERMAL BRINE RESOURCES FOR A PROOF-OF-CONCEPT FACILITY**
Frank A. Comprelli May 1975 175 p refs
(Grant NSF AER-74-19931)
(PB-245264/7; NSF/RA/N-75-049) Avail: NTIS HC $6.75 CSCL 10B

The technical, environmental, and economic feasibility is examined of using hot brine resources for electric power production and other industrial applications. Site selection, energy conversion process evaluation, conceptual design, implementation plan and schedule, and capital cost estimate are discussed. GRA

**N76-16646#** Virginia Energy Office, Richmond.
**SUMMARY AND RECOMMENDATIONS OF THE ELECTRICITY COSTS COMMISSION Final Report**
1 Jul. 1975 45 p
(PB-245179/7; VEO-75/03) Avail: NTIS HC $4.00 CSCL 10A

The summary contains introductory remarks on the energy supply and demand picture and the complete recommendations of the commission. Background for these recommendations is contained in the full report. GRA

**N76-16647#** Electric Power Research Inst., Palo Alto, Calif.
**CONFERENCE PROCEEDINGS: FUEL CELL CATALYSIS WORKSHOP**
Arnold P. Fickett Aug. 1975 188 p Workshop held at Palto Alto, Calif., 15-17 Jan. 1975
(PB-245115/1; EPRI-SR-13) Avail: NTIS HC $7.50 CSCL 10B

Contents: Overview - (participants, questionnaire response); purpose and objectives of the workshop; fuel cell electrocatalyst considerations; inhibition, of sintering in supported fuel, cell catalysts; low temperature fuel cells - 1 - (oxygen electrode kinetics on various electrode surfaces; oxygen reduction below 200C; The role of oxides on the electroreduction of oxygen on noble metals); low temperature fuel cells - 2 -(spillover effects on supported fuel cell catalysts; carbon electrodes; direct hydrocarbon electrocatalysis; high temperature fuel cell; role of catalysts; new concepts/techniques. GRA

**N76-16648#** Mitre Corp., McLean, Va.
**STRATEGIC IMPLICATIONS OF SOLAR ENERGY FOR EMPLOYMENT OF SHEET METAL WORKERS**
H. W. Brock, G. R. Murray, J. D. McConnell, and J. C. Snipes Jun. 1975 116 p Sponsored by Sheet Metal Workers' International Assoc., Washington, D.C.
(PB-245670/5) Avail: NTIS HC $5.50 CSCL 13A

The present situation and the future outlook for for energy in the United States is reviewed. Solar and other energy related technological developments are discussed along with probable impacts of solar energy on sheet metal works. Strategic alternatives for the sheet metal Union are identified. GRA

**N76-16649#** Massachusetts Inst. of Tech., Cambridge. Dept. of Architecture.
**EXPLORING SPACE CONDITIONING WITH VARIABLE MEMBRANES Report, 1 Jan. 1974 - 30 Apr. 1975**
Timothy E. Johnson, Sean Wellesley-Miller, Day Chahroudi, John Brooks, Steve Wagner, Conrad Heeschen, and Dave Bryan Apr. 1975 117 p refs
(Grant NSF GI-41306)
(PB-245137/5; NSF/RA/N-75-058) Avail: NTIS HC $5.50 CSCL 13A

Generalized variable membrane designs that could be applied to a variety of building types are examined. Topics discussed include: (1) generalized design criteria and performance specifications for variable membranes, (2) physical principles, (3) theoretical solutions as determined by morphological analysis, (4) feasible solutions based on theoretical and empirical findings, (5) test assembly design and evaluation, (6) actual structures utilizing these concepts, and (7) related projects of the MIT Solar Energy Lab. GRA

**N76-16650#** Federal Energy Administration, Washington, D.C. Office of Energy Conservation and Environment.
**LIGHTING AND THERMAL OPERATIONS. ENERGY MANAGEMENT ACTION PROGRAM FOR COMMERCIAL-PUBLIC-INDUSTRIAL BUILDINGS**
Nov. 1974 59 p
(PB-245047/6; FEA/D-74/136) Avail: NTIS HC $4.50 CSCL 13A

Desirable targets for lighting and thermal operations are discussed, including guidelines for illumination levels, efficiency in lighting, and operating cooling and heating systems. Energy savings in selected buildings in areas of illumination, thermostat setting, building occupancy, and fan operation are given GRA

# 45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

**N76-16651** Kansas Univ., Lawrence.
**AN URBAN ATMOSPHERIC DISRUPTION INDEX SET FOR MIDWESTERN CITIES Ph.D. Thesis**
James LeRoy Huckabay 1975 115 p
Avail: Univ. Microfilms Order No. 75-30044

A set of empirical indices of potential atmospheric disruptions were developed for cities of various sizes in the Midwest. This index set is based primarily on data gathered during an eighteen-month period in three major Kansas and Missouri cities--Kansas City, Topeka, and Lawrence--and several smaller towns and regional shopping centers. Meteorological anomalies measured included morning (pre-dawn) and afternoon temperature (heat islands), morning and afternoon relative humidity, solar radiation, and convective activity. Pollutant anomalies were found for sulfur dioxide and fine particulates. Calculations of human comfort and stress were carried out for the cities studied. All parameters and data were plotted against the log valve of the acreage of the heat island 'generator' where they were measured, using a simple linear regression program. The resulting equations comprise the Urban Atmospheric Disruption Index Set. Dissert. Abstr.

**N76-16652** California Univ., Davis.
**TOWARD A MATHEMATICAL THEORY OF ENVIRONMENTAL MONITORING, THE INFREQUENT SAMPLING PROBLEM Ph.D. Thesis**
Kenneth David Pimentel 1975 398 p
Avail: Univ. Microfilms Order No. 76-1802

An environmental monitor is taken to be a system which generates estimates of environmental pollutant levels throughout an environmental region for all times within a time interval of interest from measurement data taken only at discrete times and only at discrete locations in that region. The following optimal environmental monitoring problems are addressed: determine the optimal monitoring program - the numbers and types of measurement devices, the locations where they are deployed and the timing of those measurements - which minimizes the total cost of taking measurements while maintaining the error in the pollutant estimate below some bound throughout the time interval of interest. Diffusive pollutant transport in distributed environmental systems is treated with the method of separation of variables to obtain a set of stochastic first-order ordinary differential state equations for the process. Dissert. Abstr.

**N76-16653*#** Army Construction Engineering Research Lab., Champaign, Ill.

**EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIR ON THE ENVIRONMENT AND ECOLOGY Progress Report, 1 Oct. - 30 Dec. 1975**
R. K. Jain, Principal Investigator 10 Jan. 1976 5 p ERTS (E76-10125; NASA-CR-146058) Avail: NTIS HC $3.50 CSCL 08H

There are no author-identified significant results in this report.

**N76-16654*#** Scientific Translation Service, Santa Barbara, Calif.
**WATER POLLUTION MONITORING SYSTEM**
M. Matsuda and Y. Takeda Washington NASA Jan. 1976 30 p refs Transl. into ENGLISH from Nippon Denki Gimo (Japan), no. 2, Mar. 1975 p 73-81
(Contract NASw-2791)
(NASA-TT-F-16860) Avail: NTIS HC $4.00 CSCL 13B

The effects of water pollution upon humans are outlined. A monitoring system is proposed for checking water pollution, and the measurement instruments are described. The introduction of telemetry systems and computers is analyzed. Author

**N76-16655#** Loughborough Univ. of Technology (England). Dept. of Transport Technology.
**AIRPORT NOISE EXPOSURE ESTIMATION Final Report**
Davis Brown May 1975 168 p refs
(Contract SN/1170/012)
(TT-7504) Avail: NTIS HC $6.75

Aircraft traffic noise was examined in relation to its predictive estimation. The basic properties of an exposure are shown to be mainly defined by the statistics of peak-levels and noise durations. The relationship between these was derived and used to develop a method for the prediction of various noise index quantities such as NNI (Noise Number Index), Leq (equivalent continuous energy levels), L sub NP (noise pollution level), L10 (level exceeded for 10%), etc., based on information usually acquired for an NNI assessment. The index Leq is shown to be expressible in a form similar to NNI. Author (ESA)

**N76-16656#** Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
**NOISE MEASUREMENTS ON CUTTING TORCHES, FLAME BURNERS AND PLASMA BURNERS [GERAEUSCHMESSUNGEN AN SCHNEID-, FLAEMM- UND PLASMABRENNERN]**
A. Dinkelacker, W. J. Hiller, W. Kraemer, and G. E. A. Meier Nov. 1974 207 p refs In GERMAN Sponsored by Firma Messer Griesheim GmbH
(Rept-9/1974) Avail: NTIS HC $7.75; Max-Planck-Inst. fuer Stroemungsforsch., Goettingen, West Ger. DM 48

The noise behavior of free burning cutting torches, flame burners, and a plasma burner, twelve in total, was investigated. The noise measurements, presented in some hundred diagrams and tables, were evaluated. Results show that the maximum noise level, as measured at a distance of 1 m from the nozzle, varies between 93 dB(A) and 120 dB(A) The burner noise depends not only on the pressure mixing ratio and flow velocity at the nozzle exit, but probably also on the influence of the flames on the cutting oxygen jets, on the influence of superimposed air flows, and on the nozzle geometry. ESA

**N76-16657#** Houston Univ., Tex. Coll. of Business Administration.
**AN INTEGRATED POWER PROCESS MODEL OF WATER USE AND WASTEWATER TREATMENT IN OLEFINS PRODUCTION Final Report**
John C. Stone, Andrew K. Schwartz, Jr., Robert A. Klein, F. Dail Singleton, Jr., James A. Calloway, and Russell G. Thompson 27 May 1975 271 p refs
(Grant NSF GI-34459)
(PB-244269/7; NSF/RA/E-75-032) Avail: NTIS HC $9.00 CSCL 13B

The effects of increasingly restrictive wastewater effluent standards and higher water withdrawal prices on the costs of production, the use of water, and the use of energy were evaluated for an ethylene plant. Particular emphasis is placed upon the treatment of organic pollutants and consideration of the complementarities achievable within the wastewater treatment system. The organic pollutants evaluated are oil, biological oxygen demand (BOD), chemical oxygen demand (COD), and phenols. Inorganic pollutants evaluated are suspended solids and dissolved solids. This evaluation is based on a linear economic model which uses nonlinear models of the important treatment units to calibrate the water use and waste treatment costs of the linear model. GRA

**N76-16658#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**A REVIEW OF SOME EXPERIMENTAL MEASUREMENTS ON DETECTORS FOR TRACE CHEMICALS IN THE ATMOSPHERE Final Report**
R. D. Shelton and W. A. Wall Jul. 1975 37 p refs
(DA Proj. 1T1-61102-B-53A)
(AD-A014946; BRL-1798) Avail: NTIS CSCL 07/4

A number of detectors for trace contaminants in the atmosphere have been developed and tested for environmental measurements, military surveillance, and law enforcement. This paper summarizes the work done by an Army laboratory in the area of detector development and evaluation, and speculates on future evolution in this important area. Detectors subjected to development and evaluation included electric quadrupole mass spectrometers, thin film detectors, biochemical sensors, dogs, ion mobility spectrometers, electron capture devices, condensation nuclei detectors, and remote sensors. Author (GRA)

**N76-16659#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
**IMPLEMENTATION PLAN REVIEW FOR NEW HAMPSHIRE AS REQUIRED BY THE ENERGY SUPPLY AND ENVIRONMENTAL COORDINATION ACT Final Report**
Feb. 1975 37 p Prepared in cooperation with TRW, Inc., Vienna, Va.
(PB-244916/3; EPA-450/3-75-014) Avail: NTIS HC $4.00 CSCL 13B

Revisions of control regulations for stationary fuel combustion sources which do not interfere with attainment and maintenance of the national ambient air quality standards are suggested. The changes would make it possible to alter fuel resource allocations to provide clean fuel savings in a manner consistent with environmental and national energy needs. GRA

**N76-16660#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
**IMPLEMENTATION PLAN REVIEW FOR OHIO AS REQUIRED BY THE ENERGY SUPPLY AND ENVIRONMENTAL COORDINATION ACT Final Report**
Dec. 1974 69 p refs Prepared in cooperation with TRW, Inc., Vienna, Va.
(PB-244915/5; EPA-450/3-74-067) Avail: NTIS HC $4.50 CSCL 13B

For abstract, see N76-16659.

**N76-16661#** Air Products and Chemicals, Inc., Marcus Hook, Pa. Houdry Div.
**ENGINEERING AND COST STUDY OF AIR POLLUTION CONTROL FOR THE PETROCHEMICAL INDUSTRY. VOLUME 7: PHTHALIC ANHYDRIDE MANUFACTURE FROM ORTHO-XYLENE**
W. A. Schwartz, F. B. Higgins, Jr., J. A. Lee, R. B. Morris, and R. Newirth Jul. 1975 108 p refs
(Contract EPA-68-02-0255)
(PB-245277/9; EPA-450/3-73-006-G-Vol-7) Avail: NTIS HC $5.50 CSCL 07A

This document was prepared to assist in determining those petrochemical processes for which standards should be promulgated. A total of nine petrochemicals produced by twelve distinctly different processes was selected for this type of indepth study. A combination of expert knowledge and an industry survey was used to select these processes. This volume covers the manufacture of phthalic anhydride from ortho-xylene. Included is a process and industry description, an engineering description of available emission control systems, the cost of these systems, and the financial impact of emission control on the industry. Also presented are suggested air episode procedures and plant inspection procedures. GRA

**N76-16662#** Industrial Gas Cleaning Inst., Inc., Stamford, Conn.
**AIR POLLUTION CONTROL TECHNOLOGY AND COSTS: SEVEN SELECTED EMISSION SOURCES Final Report**
Dec. 1974 334 p refs
(Contract EPA-68-02-1091)
(PB-245065/8; EPA-450/3-74-060) Avail: NTIS HC $10.00 CSCL 07A

Collected and formalized data on air pollution abatement for seven selected industrial emission sources are discussed. These seven sources were: Kraft paper mills; ferroalloy furnaces; grain cleaning houses; glass melting furnaces; crushed stone and aggregate; asphalt saturation; and surface coating operation. For each source area studied, costs of conventionally applied pollution control systems are presented for a range of plant sizes and control efficiencies. GRA

**N76-16663#** Enviro-Systems and Research, Inc., Roanoke, Va.
**APPLYING FABRIC FILTRATION TO COAL FIRED INDUSTRIAL BOILERS: A PILOT SCALE INVESTIGATION Final Report, Jun. 1974 - Apr. 1975**
John D. McKenna, John C. Mycock, and William O. Lipscomb
Aug. 1975 203 p refs
(Contract EPA-68-02-1093)
(PB-245186/2; EPA-650/2-74-058-a) Avail: NTIS HC $7.75 CSCL 13B

Results are given of a pilot scale investigation to determine the technoeconomic feasibility of applying a fabric filter dust collector to coal fired industrial boilers. The pilot facility, on a slip stream of a 60,000 lb/hr boiler, was capable of handling 11,000 acfm at an air-to-cloth (A/C) ratio of 6.1. Filter media evaluated were Nomex felt, Teflon felt (two styles), Gore-Tex, and Dralon-T. Fractional efficiency was determined using an Andersen inertial impactor for the four filter media at three A/C levels. The effect of reverse air volume on outlet loading and pressure drop across the bags was evaluated for Nomex felt. Nomex felt achieved the lowest outlet dust concentrations while Teflon felt operated at the lowest pressure drop. All media tested achieved outlet loadings well within allowable limits. Higher collection efficiencies were achieved with Nomex felt by discontinuing reverse air cleaning. Increasing the amount of air used for cleaning does reduce the pressure drop across the bags. Installed annual operating and total annualized costs for a fabric filter and an electrostatic precipitator, capable of handling 70,000 acfm of flue gas from a coal fired boiler, are presented. GRA

**N76-16664#** National Environmental Research Center, Research Triangle Park, N.C. Quality Assurance and Environmental Monitoring Lab.
**COMPARISON OF METHODS FOR DETERMINATION OF NITROGEN DIOXIDE IN AMBIENT AIR Final Environmental Monitoring Series**
L. J. Purdue, G. G. Akland, and E. C. Tabor Jun. 1975 97 p refs
(PB-245025/2; EPA-650/4-75-023) Avail: NTIS HC $5.00 CSCL 13B

Four methods for the measurement of nitrogen dioxide in ambient air were studied concurrently to determine the comparability of the data generated under a variety of controlled conditions. Included were two automated continuous methods (chemiluminescence and colorimetric) and two manual methods (arsenite and TGS-ANSA). Simultaneous nitrogen dioxide measurements were made on a common air source using duplicate analyzers for each of the automated methods and quadruplicate samples for each of the manual methods. Measurements were made on ambient air to which extra NO2 was added in order to provide a wider range of concentrations. The effect of variable NO2 concentration during a sampling period was determined. Suspected ozone interference with the automated continuous colorimetric method was also investigated. The methods produce data that are in good agreement except in the case of the colorimetric method, which yields low results in the presence of high ozone concentrations. GRA

**N76-16665#** Cincinnati Univ., Ohio. Dept. of Environmental Health.
**DEVELOPMENT OF AIR SAMPLING METHODOLOGY Final Environmental Protection Technology Series**
Bernard E. Saltzman May 1975 42 p
(Grant EPA-R-800869)
(PB-245026/0; EPA-650/2-75-067) Avail: NTIS HC $4.00 CSCL 13B

Solid absorbent systems were developed for analysis of three gaseous ambient air pollutants. Nitrogen dioxide was sampled with small glass tubes packed with copper shot, which could be used as personal samplers, and be stored before analysis for up to 5 weeks. Reactive hydrocarbons were determined in a dual analyzer as the concentration absorbed on chromium trioxide-sulfuric acid. These monitoring measurements should correlate better with photochemical reactivity than those of non-methane hydrocarbons. Permeation tubes for vinyl chloride were critically examined and successfully used to optimize the carbon tube sampling method. Time patterns of monitoring data were examined by Fourier analysis on a computer. GRA

**N76-16666#** Little (Arthur D.), Inc., Cambridge, Mass.
**INCINERATOR OVERFIRE MIXING DEMONSTRATION Final Report, 1971 - 1974**
T. J. Lamb, R. H. Stephens, C. M. Mohr, P. C. Levins, and L. K. Fox Aug. 1975 162 p refs
(Contract EPA-68-02-0204)
(PB-245015/3; ADL-73722; EPA-600/2-75-016) Avail: NTIS HC $6.75 CSCL 13B

Overfired air jets were used in coal stokers to induce turbulence for increased combustion efficiency and reduced emissions of combustible pollutants such as CO, H2, hydrocarbons, and soot. A mixing system of this type was installed in an existing municipal incinerator. Measurements were made in the furnace breech, directly over the refuse bed, and in the furnace stack. Generalized models were developed to describe bed burning, furnace flow behavior, and overfire mixing phenomena. Jets were shown to be effective in reducing combustible emissions through temperature control. They were only marginally effective in inducing increased turbulence within the furnace. Analysis of test results and rationale for the conclusions drawn are discussed. GRA

**N76-16667#** Midwest Research Inst., Kansas City, Mo.
**HAZARDOUS EMISSION CHARACTERIZATION OF UTILITY BOILERS Final Report, Nov. 1973 - Jul. 1975**
Chatten Cowherd, Jr., Mark Marcus, Christine M. Guenther, and James L. Spigarelli Jul. 1975 185 p refs
(Contract EPA-68-02-1324)
(PB-245017/9; EPA-650/2-75-066) Avail: NTIS HC $7.50 CSCL 13B

Results of a field sampling program, aimed at quantifying potentially hazardous pollutants in the waste streams of a representative coalafired utility boiler - a 125-MW boiler at TVA'S windows Creek steam electric generating station, are reported. The combustion products identified as potentially hazardous air pollutants included 22 trace elements, nitrates, sulfates, polycyclic organic compounds, and polychlorinated biphenyls. The waste streams sampled included pulverized coal, furnace bottom ash, superheater ash, collection ash, and flue gases at the fly ash collector inlet and outlet. Acceptable mass balance was achieved for about half of the elemental pollutants. Trace metal enrichment was measured. Study results include recommended modifications of sample collection and preparation methods. GRA

**N76-16668#** Acurex Corp., Mountain View, Calif. Aerotherm Div.
**APPLICATION OF AUTOMATIC DATA PROCESSING TECHNOLOGY TO LABORATORY PROBLEMS Final Report, Jun. 1974 - May 1975**
Larry Babb and Fredric Jaye Apr. 1975 56 p refs
(Contract EPA-68-02-1436)
(PB-244886/8; EPA-650/2-75-035) Avail: NTIS HC $4.50 CSCL 13B

The report describes the design, acquisition, programming, and installation of a multiprogramming data acquisition system. Two multichannel experiments and a high-speed laser doppler velocimeter were interfaced. The laser velocimeter was interfaced by a bi-directional ASC II communication link. The minicomputer operating system supports several foreground data acquisition programs with concurrent background data processing. GRA

**N76-16669#** Colorado State Univ., Fort Collins. Environmental Resources Center.
**INDIVIDUAL HOME WASTEWATER CHARACTERIZATION AND TREATMENT**
Edwin R. Bennett and K. Daniel Linstedt Jul. 1975 148 p refs Prepared in cooperation with Colorado Univ., Boulder
(Contract DI-14-31-0001-5006)
(PB-245259/7; W75-11852) Avail: NTIS HC $6.00 CSCL 13B

Disposal of wastewater from isolated homes in mountain and rural locations in Colorado presents unique and difficult problems. The flow and pollution patterns from individual homes are examined along with existing and potential treatment methods. Field evaluation of home wastewater flow and pollutional characteristics was accomplished. Data for individual fixtures and appliances were obtained with measurement of many pollutional parameters. A brief evaluation of the home treatment methods was accomplished. GRA

**N76-16670#** California State Coll., Turlock.
**INVESTIGATION OF PARTICULATE MATTER MONITORING USING CONTACT ELECTRIFICATION Final Report**
John Walter Feb. 1975 52 p refs
(Contract EPA-802726)
(PB-245055/9; EPA-650/2-75-043) Avail: NTIS HC $4.50 CSCL 14B

The theory of the charging of aerosol particles by contact electricity is reviewed, as well as the development of monitors for particulate matter based on this principle. Data on the performance of these monitors is scarce and sometimes contradictory. In the present work, laboratory tests were carried out with a variety of test dusts. The results show that the dynamic response of the contact electricity monitor tracks well with that of an optical detector. The total charge correlates well with the gravimeteric mass. Humidity or precharge on the particles did not influence the detector. Some evidence was obtained showing that particle size does not have an important effect on the response, although there is a cutoff for very small particles. Results for the sensitivity of the instrument can be grouped according to electrical resistivity of the material. It is found that the condition of the surface of the Inconel probe has a major effect on the sensitivity. Additional work is necessary on this aspect of the detector. The Theory of Cheng and Soo for the charging of metal particles is discussed. GRA

**N76-16671#** Exxon Research and Engineering Co., Linden, N.J. Products Research Div.
**PARTICULATE EMISSIONS FROM PROTOTYPE CATALYST CARS Environmental Protection Technologies Series, Jun. 1974 - May 1975**
Morton Beltzer May 1975 225 p refs
(Contract EPA-68-02-1279)
(PB-244889/2; EPA-650/2-75-054) Avail: NTIS HC $7.75 CSCL 13B

Particulate emissions from a vehicle equipped with a variety of commercial and prototype catalyst systems were measured and characterized. Nine catalysts, including four monolithic and three pelleted oxidation catalysts and two NO(x) reduction catalysts were screened on three test fuels over the 1975 FTP driving cycle and three study states. Particulate emissions increased due to the formation of sulfuric acid from exhaust SO2. This sulfuric acid together with bound water accounted for most of the particulate emitted. Sulfate was the only form of sulfur detected in the particulate. Substantial differences between oxidation catalysts in their sulfuric acid formation tendency were detected. Additional information on the particle size distribution and metals content of the particulate is included. GRA

**N76-16672#** National Academy of Sciences - National Research Council, Washington, D.C. Environmental Studies Board.
**UNDERGROUND DISPOSAL OF COAL MINE WASTES**
Mar. 1975 184 p refs
(Contract NSF C-310)
(PB-245130/0; ISBN-0-309-02324-6; LC-74-32597) Avail: NTIS MF $2.25; HC available from Natl. Acad. of Sci., 2101 Constitution Ave., Washington, D.C. 20418 $6.25 CSCL 08I

The report assesses the technological and economic feasibility of underground refuse disposal in the context of the full resource problem, considering the subsequent effect on the underground mining environment, costs and benefits as compared to other options, legal parameters, and related health factors. Considerations include safety of miners, groundwater contamination, backfilling methods, and losses in productivity. Existing legislation for coal mine waste disposal is reviewed. Tables and figures augment the text. GRA

**N76-16673#** Southern Research Inst., Birmingham, Ala.
**PARTICULATE SIZING TECHNIQUES FOR CONTROL DEVICE EVALUATION Summary Report, Jul. 1974 - Jun. 1975**
W. B. Smith, K. M. Cushing, C. E. Lacey, and J. D. McCain Aug. 1975 135 p refs
(Contract EPA-68-02-0273)
(PB-245184/7; SORI-EAS-75-368; EPA-650/2-74-102-a) Avail: NTIS HC $6.00 CSCL 13B

Results are described of laboratory and field work related to inertial particulate size classifiers (impactors and cyclones). Preparation and handling procedures for using glass fiber impaction substrates are discussed, together with problems resulting from SO2 reactions with certain types of glass fiber filter media. The results of a brief series of tests of electrostatic effects in impactor sampling are described. Design and calibration data are given for two series cyclone size devices: one designed to operate at a flowrate of 140 liters/minute (5 cfm); and the other, at 28 liters/minute (1 cfm). The cyclone systems permit collection of larger quantities of size fractionated particulates and are somewhat easier to use than are impactors. GRA

**N76-16674#** Southwest Research Inst., San Antonio, Tex.
**METHODOLOGY FOR DETERMINING FUEL EFFECTS ON DIESEL PARTICULATE EMISSIONS Final Report, Jun. 1973 - Feb. 1975**
Charles T. Hare Mar. 1975 193 p refs
(Contract EPA-68-02-1230)
(PB-245163/1; EPA-650/2-75-056) Avail: NTIS HC $7.50 CSCL 13B

A methodology was developed for characterizing particulate emissions from diesel engines. A 2-stroke cycle engine and a 4-stroke cycle engine were operated in both individual steady-state modes and according to a variation of the 13-mode diesel emissions measurement procedure on three fuel types, each of which was used with one of two available diesel fuel additives as well as by itself. The primary particulate sampling technique employed was a dilution tunnel; and secondary evaluation techniques included a diluter-sampler developed under contract to EPA by another organization, a light extinction smokemeter, and a filter-type sampling smokemeter. Gaseous emissions were measured. Particulate mass rates were calculated from gravimetric data. GRA

**N76-16675#** United Technologies Research Center, East Hartford, Conn.
**INFLUENCE OF AERODYNAMIC PHENOMENA ON POLLUTANT FORMATION IN COMBUSTION. VOLUME 1: EXPERIMENTAL RESULTS Final Report, Jul. 1973 - Dec. 1974**
Craig T. Bowman and Leonard S. Cohen Jul. 1975 159 p refs
(Contract EPA-68-2-1092)
(PB-245344/7; EPA-650/2-75-061-A) Avail: NTIS HC $6.75 CSCL 13B

Results are given of the measurement of average concentration levels of NO, NO2, CO, and unburned hydrocarbons (THC) at the exhaust of an axisymmetric combustor over a significant range of operating conditions. In addition, it gives detailed species concentration, temperature, and velocity maps throughout the combustor for seven representative operating conditions. Water-cooled probes were used to remove samples from the flow for on-line concentration analysis and to measure temperature, velocity, and flow direction. Elevated pressure and introduction of swirl, create 'unmixedness' in the combustor flow field which in turn results in enhanced NO formation and consumption of hydrocarbons. Aerodynamic flame stabilization produces strong stirring which results in relatively low NO formation and hydrocarbon consumption rates. GRA

**N76-16676#** Massachusetts Inst. of Tech., Cambridge. Energy Lab.
**IMPROVEMENT OF THE ENVIRONMENTAL AND ECONOMIC CHARACTERISTICS OF COOLING TOWERS. THE PERIODIC COOLING TOWER-SMALL SCALE, FULL SCALE, AND SURFACE ROUGHENING TESTS Annual Report, 1974 - 1975**
PouCheong Hon, Je-Chin Han, Paul F. Pilger, David A. Fink, and Bruce R. Andeen 30 Jun. 1975 149 p refs Prepared in cooperation with Empire State Electric Energy Research Corp., N.Y.
(PB-245348/8; MIT-EL-75-018) Avail: NTIS HC $6.00 CSCL 13A

Research on the Periodic Cooling Tower is described. The Periodic Tower consists of rotating sheet metal discs partially immersed in hot, power plant condensor effluent. The tower can be either wet or dry, depending upon the amount of water carried into the air side on the plates' surface. An oil layer, floating on the water's surface is effective in eliminating water carryover. The year's emphasis was placed on: (1) scale model flow and heat transfer tests, (2) completion of a facility for testing full sized modules, and a parametric study of the oil film thickness on the discs, and (3) construction, instrumentation, and calibration of a test apparatus to study the further enhancement of disc performance by surface roughening. GRA

**N76-16677#** National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.
**OCEAN DUMPING IN THE NEW YORK BIGHT**
Charles G. Gunnerson and R. L. Swanson Mar. 1975 83 p refs
(COM-75-11390/2; NOAA-TR-ERL-321; MESA-2; NOAA-75091802) Avail: NTIS HC $5.00 CSCL 13B

The New York Bight extends seaward over 15,000 square miles from Long Island and New Jersey to the edge of the continental shelf, some 80-100 nautical miles off-shore. Wastes from 20 million people are discharged to the Bight. These wastes arrive by a variety of routes: ocean dumping, outfall sewers, air pollution, river discharge, land runoff, thermal discharges, vessel wastes, and occasional spills. Although impacts of these wastes on the marine environment are not clearly understood, there is evidence that the waters, bottom sediments, and living resources are under stress. An average of 260 million cu ft 7,400,000 cu m per year of dredge spoils were dumped each year between 1965 and 1970, as well as waste acid, and construction and demolition debris. The hazards of this dumping are not known, however above normal incidence of fin-rot disease in fish in the area and the closing of the area to shellfishing are indications that something is wrong. GRA

**N76-16678#** Rhode Island Univ., Kingston. Dept. of Ocean Engineering.
**AN IN-SITU INVESTIGATION OF OIL BARRIER SHAPE AND DRAG COEFFICIENTS Final Report**
Richard M. Larrabee and George A. Brown 1 Jul. 1974 219 p refs
(Contract DOT-CG-33962-A)
(AD-A017099; USCG-D-161-75) Avail: NTIS CSCL 13/2

In-situ experimentation on a moored 100 foot section of commercially procured oil barrier was carried out. The objectives of this study were three-fold: To study oil barrier shape and tensions as influenced by current and wave action, to analyze data on the barrier shape with existing analyses and to compare results of tension and drag coefficient data with previous investigations. Actual barrier shape, measured by transit, was compared to a theoretical catenary drawn through the barrier end points. Shape, load, current, and wave data were used to calculate various drag coefficients for the boom. Two techniques were used to calculate drag coefficients for the barrier and results of each were compared. The effects of wave action on barrier loading were determined by the analysis of two previous investigators and the results compared. Values of drag coefficient were reduced to a basic drag coefficient, independent of barrier shape configuration as well as wave effects. Results of the investigation showed that the catenary curve is a good approximation to barrier shape. GRA

**N76-16679#** Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
**AIR POLLUTION ENGINEERING SPECIAL STUDY, AMBIENT AIR QUALITY INSTRUMENT STUDY Technical Report, 23 May - 28 Jul. 1975**
William T. Coats 20 Nov. 1975 19 p
(AD-A017517; USAEHA-21-008-74/76) Avail: NTIS CSCL 14/2

An evaluation is presented of the accuracy and precision of selected SO2 and NO2 instruments. Author (GRA)

**N76-16680#** Enviro Control, Inc., Rockville, Md.
**VULNERABILITY MODEL: A SIMULATION SYSTEM FOR ASSESSING DAMAGE RESULTING FROM MARINE SPILLS Final Report**
Norman A. Eisenberg, Cornelius J. Lynch, and Roger J. Breeding Jun. 1975 354 p refs
(Contract DOT-CG-33377-A)
(AD-A015245; USCG-D-136-75) Avail: NTIS CSCL 13/2

The Vulnerability Model (VM) is a computerized simulation system for assessing damage that results from marine spills of hazardous materials; the final report, summarized here, describes the research background, computational techniques, and preliminary test results associated with the first stage of development of the VM. This first stage of model development consisted of the design and implementation of an operational computer simulation, thereby demonstrating the feasibility of the philosophy, concepts, and approaches pertaining to the VM. Certain aspects of the modeling, as now operational, are subject to enhancement by augmentation, increase in precision, or both. Ultimately, the model is intended to be a comprehensive tool for assessing damage resulting from marine spills. GRA

# 46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

**N76-16681** Pennsylvania State Univ., University Park.
**DYNAMIC FINITE ELEMENT ANALYSIS WITH APPLICATIONS TO SEISMOLOGICAL PROBLEMS Ph.D. Thesis**
Douglas William McCowan 1975 197 p
Avail: Univ. Microfilms Order No. 76-1332

A method is presented that is able to reproduce temporal and phase characteristics of Rayleigh waves such as travel time, group velocity dispersion, ellipticity, and phase lag to within 5% of the values predicted by theory. The Rayleigh wave amplitude, however, was found to be 25% small over the whole spatial waveform, an effect which was attributed to the artificial viscosity in the method necessary to remove severe numerical noise. Three seismological problems of interest were solved: (1) Rayleigh wave propagation across a continental margin structure, (2) radiation from an extended shear source, and (3) a static and dynamic study of the February 9, 1971 San Fernando earthquake. Dissert. Abstr.

**N76-16682** Pennsylvania State Univ., University Park.
**CRUST-MANTLE STRUCTURE IN CONTINENTAL SOUTH AMERICA AND ITS RELATION TO SEA FLOOR SPREADING Ph.D. Thesis**
Roger Wayne Sherburne 1975 153 p
Avail: Univ. Microfilms Order No. 76-1380

Phase and group velocities were determined for Rayleigh and Love type surface waves for different propagation paths which were confined to the South America Continent east of the Andes. Data indicate that this entire region is laterally uniform and structurally similar to other shields, at least to a depth of approximately 400 km. Additional geophysical evidence reveals that the upper mantle shield structure is significantly different from the ocean type mantle structure; thus the South American shield area may be characterized by the lack of low velocity layer (or at least a pronounced one) for S waves, high Q (specific dissipation function), low heat flow values, and high electrical resistivity. The observed surface wave dispersion clearly

indicates a structural difference between the South American continent and the South Atlantic ocean. The similarity of South African and South American surface wave dispersion indicates the structured similarity of the two areas. Dissert. Abstr.

**N76-16683*#** Pennsylvania State Univ., University Park. Ionosphere Research Lab.
**IONOSPHERIC RESEARCH Semiannual Status Report, 1 Apr. - 30 Sep. 1975**
30 Sep. 1975 54 p refs
(Contract NAS6-2602; Grants NGL-39-009-003; NGR-39-009-218; NGL-39-009-002; NGR-39-009-032)
(NASA-CR-146137; PSU-IRL-SAR-75/2; SASR-2) Avail: NTIS HC $4.50 CSCL 04A

Data from research on ionospheric D, E, and F, regions are reported. Wave propagation, mass spectrometer measurements, and atmospheric reactions of HO2 with NO and NO2 and NH2 with NO and O2 are summarized. E.H.W.

**N76-16684*#** Old Dominion Univ. Research Foundation, Norfolk, Va. Dept. of Physics and Geophysical Sciences.
**DIFFERENTIAL ABSORPTION AND SCATTERING SENSITIVITY PREDICTIONS Technical Report, Jun. 1974 - Nov. 1975**
Richard T. Thompson, Jr. Dec. 1975 43 p refs
(Grant NsG-1060)
(NASA-CR-146139; PGSTR-PH75-19) Avail: NTIS HC $4.00 CSCL 04A

Equations for evaluating the sensitivity of the Differential Absorption and Scattering (DAS) technique based upon a conventional analysis of statistical errors were derived. The equations were put in a proper form for evaluating total column density and range resolved concentration measurements of several atmospheric species. The equations were subsequently used to analyze the sensitivity of DAS in three specific applications assuming realistic parameters for the optical and electronic components of proposed DAS systems. The three DAS applications evaluated were: (1) measurement of nitrogen dioxide at ground levels over a horizontal path, (2) measurement of ozone depletion in the wake of a jet engine at 20 km altitude, and (3) measurements of ozone distribution from an orbiting space platform, in a downward viewing mode. The results of this study demonstrate that with reasonable laser energy and telescope receiver dimensions, DAS is capable of meeting requirements for performing these measurements. Author

**N76-16685#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**DESIGN OF BARKER CODE MULTIPLE PULSE EXPERIMENTS**
C. J. Zamlutti Aug. 1975 27 p refs
(INPE-708-RRE/018) Avail: NTIS HC $4.00

The problems concerning the implementation of experiments combining the benefits of the Barker code and multiple pulse techniques for incoherent scatter studies of the lower ionosphere were discussed. Solutions were suggested in some particular cases. It was shown that a frequency resolution of 1 kHz is possible during ionospheric modification experiments, together with a height resolution of 600 m. Author

**N76-16686#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**AIRGLOW STUDIES OF THE NIGHTTIME DYNAMICS OF THE IONOSPHERE NEAR ARECIBO**
Jose H. A. Sobral, H. C. Carlson, and D. T. Farley 19 May 1975 28 p refs
(Grant NSF GA-36771X)
(INPE-663-PE/003) Avail: NTIS HC $4.00

Red line (6300 A) airglow measurements were made at Arecibo using a scanning photometer in order to determine the direction and velocity of propagation of major airglow enhancements, which incoherent scatter and ionosonde measurements have shown are in turn associated with pronounced descents of the F region. The most common descent occurs around midnight and is know to be due to an abatement in the equatorward meridional wind. The associated airglow enhancement was observed to travel from South to North with an average phase velocity of about 360m/sec. at 300 km of altitude. A second type of enhancement, probably due to traveling ionospheric disturbances, was occasionally observed propagating from North to South with a phase velocity of about 246 m/sec. also at 300 km altitude. Finally a third was seen which occurred almost simultaneously at all latitudes observed and was probably caused by electric field disturbances. Author

**N76-16687#** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
**CURRENT SYSTEMS IN THE MAGNETOSPHERE AND IONOSPHERE**
Rolf Bostroem Jun. 1975 29 p refs Presented at the EISCAT Summer School, Tromsoe, Norway, 5 - 13 Jun. 1975
(TRITA-EPP-75-18) Avail: NTIS HC $4.00

Currents that flow in the high latitude ionosphere and in the magnetosphere and problems that can be investigated using the EISCAT facility are identified. Topics include the magnetic effects of the combined ionospheric-magnetospheric current systems, the relation between the currents and electric fields, and mechanisms for driving the large-scale and small-scale currents. Author (ESA)

**N76-16688#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**PULSE SOUNDING WITH CLOSELY SPACED RECEIVERS AS A TOOL FOR MEASURING ATMOSPHERIC MOTIONS AND FINE STRUCTURE IN THE IONOSPHERE. 7: DATA PROCESSING WITH DIFFERENT TECHNIQUES FOR CROSS-POWER SPECTRA**
W. Pfister, G. Sales, and R. Varad 7 Apr. 1975 39 p refs
(AF Proj. 5631)
(AD-A015045; AFCRL-TR-75-0194; AFCRL-ERP-506) Avail: NTIS CSCL 04/1

Power spectra, phase spectra, and coherency spectra from a three-antenna experiment are useful for a study of ionospheric structure. Four different techniques for obtaining these spectra are described, examined, and compared. They are the Frequency-Averaging Method (FAM), the Block-Averaging Method (BAM), the Maximum-Likelihood Method (MLM) and the Autoregressive Method. Examples using measured data demonstrate the capabilities and limits of the processing techniques which from the overall viewpoint favor the FAM. GRA

**N76-16689#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**PULSE SOUNDING WITH CLOSELY SPACED RECEIVERS AS A TOOL FOR MEASURING ATMOSPHERIC MOTIONS AND FINE STRUCTURE IN THE IONOSPHERE. 8: APPLICATION TO AIRCRAFT SIGNALS**
W. Pfister and G. Sales 7 Apr. 1975 24 p refs
(AF Proj. 5631)
(AD-A014784; AFCRL-TR-75-0193) Avail: NTIS CSCL 04/1

Signals transmitted from an aircraft and received on the ground are characterized by a Doppler shift which falls outside the principal range of the instrument from -2 to +2 Hz. A data processing technique combines the Fourier spectra of three interlaced sets of data in such a way that the shifted Doppler range includes the spectrum of the aircraft signal. The shift can be either preselected or determined from the signal itself. Printouts of Fourier spectra computed by both methods are compared. GRA

**N76-16690#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**ATMOSPHERIC DENSITY VARIATIONS IN THE SOUTHERN HEMISPHERE AT LOW SATELLITE ALTITUDES Environmental Research Papers**
F. A. Marcos, K. S. W. Champion, R. E. McInerney, and D. Delorey 5 May 1975 22 p refs
(AF Proj. 6690)
(AD-A014776; AFCRL-TR-75-0254; AFCRL-ERP-512) Avail: NTIS CSCL 04/1

Accurate density measurements are required to develop predictive atmospheric models. Of particular concern is the altitude region below 250 km. Few measurements are presently available in this region and data are urgently required by the Air Force for accurate ephemeris, trajectory, and reentry predictions. Profiles of neutral atmospheric density obtained at low satellite altitudes

in the Southern Hemisphere during geomagnetically quiet conditions are described in this report. GRA

**N76-16691#** Texas Instruments, Inc., Dallas. Equipment Group.
**ESTIMATING A SEISMIC STATION'S DETECTION CAPABILITY FROM NOISE. APPLICATION TO VLPE STATIONS**
Rudolph Unger 22 Oct. 1974 108 p refs
(Contract F08606-74-C-0033; ARPA Order 2551)
(AD-A015053; TI-ALEX(01)-TR-74-04; TR-4) Avail: NTIS CSCL 17/10

Since the detection of a seismic event depends on the signal-to-noise ratio at a receiving site or station one may derive detection threshold magnitudes from the ambient noise levels. The statistical distribution of either peak noise amplitudes or RMS noise levels then determine the probability of detecting an event of a given magnitude. The conditions for the validity of this method of estimating detection capabilities, and the parameters involved, are specified. The analysis shows that results obtained from this method should differ little from maximum likelihood direct method estimates. Application of this method to stations of the Very Long Period Experiment (VLPE) confirms the analytical results. As few as 30 reliable daily noise samples yield good 50% detection threshold estimates. GRA

**N76-16692#** Texas Instruments, Inc., Dallas. Equipment Group.
**FEASIBILITY OF INTERACTIVE DATA PROCESSING IN A SEISMIC SURVEILLANCE SYSTEM**
Robert L. Sax 13 Dec. 1974 52 p refs
(Contract F08606-74-C-0033; ARPA Order 2551)
(AD-A015056; TI-ALEX(01)-TR-74-12; TR-12) Avail: NTIS CSCL 17/10

An interactive data processing system enables a seismic data analyst to interrupt and modify the automatic processing of seismic data. It results in increased efficiency of retrieving desired seismic data. Also, it results in increased capability of the analyst to accurately describe and document seismic events. Principles are described to effectively design software for a seismic interactive data processing system. A set of tasks were described in detail as promising applications. Certain functions needed for seismic surveillance will require a very effective interactive data processing system. GRA

**N76-16693#** Saint Louis Univ., Mo. Dept. of Earth and Atmospheric Sciences.
**RESEARCH IN SEISMOLOGY: EARTHQUAKE MAGNITUDES Scientific Interim Report**
Otto W. Nuttli, So Gu Kim, and Huei-Yuin Wen 18 Jul. 1975 51 p refs
(Contract F19628-73-C-0269; ARPA Order 1795)
(AD-A015065; AFCRL-TR-75-0433; SR-3) Avail: NTIS CSCL 17/10

The report presents the findings of and summarizes the research activity for the 12-month interval 1 July 1974 through 30 June 1975. During that time principal effort was devoted to gathering and analyzing body- (m sub B) and surface-wave (M sub S) magnitudes for small and intermediate magnitude events in and near Eurasia, in order to seek out shallow depth earthquakes which appear anomalous according to the m sub b:M sub S criterion. GRA

**N76-16694#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**SEISMIC DISCRIMINATION Semiannual Technical Summary Report, 1 Jan. - 30 Jun. 1975**
Michael A. Chinnery 30 Jun. 1975 79 p refs
(Contract F19628-73-C-0002; ARPA Order 512)
(AD-A014793; ESD-TR-75-205; SATSR-23) Avail: NTIS CSCL 17/10

The report describes 23 investigations in the field of seismic discrimination. These are grouped as follows: Seismic body wave studies (3 contributions), seismic surface wave studies (5 contributions), investigations of seismic source mechanisms (2 contributions), studies of earth heterogeneity and scattering phenomena (5 contributions), studies of earthquake occurrence rates (3 contributions), and outlines of progress in seismic data management system development and improvements in in-house computer facilities (5 contributions). GRA

**N76-16695#** Alaska Univ., College. Geophysical Inst.
**A PRELIMINARY STUDY OF THE FORMATION OF LANDFAST ICE AT BARROW, ALASKA, WINTER 1973 - 1974 Scientific Report**
Lewis H. Shapiro Jun. 1975 51 p refs Sponsored in part by Alaska Oil and Gas Assoc.
(Grant NOAA-04-3-158-41)
(COM-75-11344/9; UAG-R-235; NOAA-75090413; Rept-75-7) Avail: NTIS HC $4.50 CSCL 08L

During late December 1973, the landfast ice sheet at Barrow broke loose and drifted offshore, following which an intense storm drove the pack ice into the nearshore zone. As a result, a new landfast ice mass was formed, which included a complex array of pressure ridges, shear ridges, and hummock fields. The entire process was monitored by radar. Information is provided on the velocity vector of the pack ice during this time, and on the sequence of events which lead to the formation of the landfast ice. These data, in conjunction with field observations, give some insight into the mechanisms by which some of the structural features of the landfast ice mass were formed. GRA

**N76-16696#** Geological Survey, Menlo Park, Calif.
**GRAVITY DATA IN CRUMP GEYSER AREA, OREGON Final Report**
Donald Plouff Sep. 1975 18 p refs
(PB-245426/2; USGS/GD-75/019) Avail: NTIS HC $3.50 CSCL 08E

A total of 356 gravity stations were established in the Crump Geyser area, Oregon. The purpose of the gravity survey was to provide background geophysical information to assist in evaluating the geothermal resource potential of this area. Standard gravity reduction procedures were used to obtain values of the observed gravity, free air anomaly, and Bouguer anomalies. GRA

**N76-16697#** Ohio State Univ., Columbus. ElectroScience Lab.
**SPECTROPHONE SYSTEM FOR MONITORING AMBIENT AIR SAMPLES Final Report, Feb. 1973 - Nov. 1974**
E. K. Damon, J. C. Peterson, F. S. Mills, and R. K. Long Jul. 1975 43 p refs
(Contract F29601-73-C-0108)
(AD-A014832; AFWL-TR-74-300) Avail: NTIS CSCL 04/1

A spectrophone system for monitoring the extinction coefficient of ambient atmospheric samples at the P(20) CO2 laser line is described. The system is completely self-contained and transportable. Procedures for calibration, operation, and maintenance of the system are given. Author (GRA)

**N76-16698#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
**ELECTRON DISTRIBUTION FUNCTION IN A NONUNIFORM, MAGNETIZED, WEAKLY PHOTOIONIZED GAS APPLICATION TO A MODEL IONOSPHERE Environmental Research Papers**
John R. Jasperse 12 May 1975 33 p refs
(AF Proj. 8627)
(AD-A014777; AFCRL-TR-75-0266; AFCRL-ERP-514) Avail: NTIS CSCL 04/1

A plasma kinetic model is presented for the one-particle electron distribution function in a dilute, nonuniform, magnetized, weakly photoionized gas. The model includes a phenomenological treatment of photoionization of the neutral species by an externally produced photon flux, electron-ion recombination, electron-neutral particle attachment, elastic, excitation, deexcitation, and ionizing electron-neutral particle collisions, and elastic electron-electron and electron-ion collisions. Using known methods, the approximate analytic formula for the steady-state electron distribution function is obtained at energies much larger than the electron thermal energy. For a model of the earth's ionospheric E- and F-regions at low latitudes, numerical solutions for the steady-state electron distribution function are given and compared to a curve-fitted distribution function of Maxwellian form. It is shown that the effective rate of production of electrons per unit volume is significantly enhanced due to ionizing

electron-neutral particle collisions. Results for the electron concentration and the electron temperature are also given. GRA

**N76-16699#** Mission Research Corp., Santa Barbara, Calif.
**ARCTIC CODE ELECTRON DEPOSITION THEORY WITH APPLICATION TO PROJECT EXCEDE. HAES REPORT NO. 10 Topical Report, 1 Oct. 1974 - 1 Feb. 1975**
Paul W. Tarr 18 Jun. 1975 75 p refs
(Contract DNA001-74-C-0143; DNA Proj. NWET-AAXY)
(AD-A014966; MRC-R-173; DNA-3636T) Avail: NTIS CSCL 04/1

This report describes in detail the theory of electron energy deposition used in the ARCTIC auroral code. New results describing the effects of radial electron diffusion both with and without a magnetic field are presented. Detailed comparisons are made between the ARCTIC theory, data, and the results of a Monte Carlo calculation performed to check the accuracy of the theory. Some comparisons between the ARCTIC approach to the electron energy deposition problem and several other deposition methods are discussed. GRA

**N76-16700#** National Oceanic and Atmospheric Administration, Boulder, Colo.
**CATALOG OF STANDARD GEOMAGNETIC VARIATION DATA**
Aug. 1975 136 p refs
(COM-75-50279/49; UAG-49; NOAA-75091604) Avail: NTIS MF $2.25; HC available from Natl. Climatic Center, Federal Bldg. Attn: Publ., Asheville, N.C. 28801 $25.20/year, $1.85 this issue CSCL 08N

This catalog consolidates all of the geomagnetic variation data from standard and rapid-run measurements known to exist at World Data Center A for Solar-Terrestrial Physics. It includes data for time periods prior to the IGY, the earliest data set being for Batavia, Indonesia, 1867. The geomagnetic variation data in this catalog are held in the form of microfilm, magnetic tape, yearbooks and bulletins. They are in a variety of formats including magnetograms (normal, storm, and rapid-run), hourly values, 2.5 minute values, and various derived indices for individual observatories as well as for selected groupings of observatories. The data from about 300 observatories are referenced in this catalog, and a list of observatories along with their geographic and geomagnetic coordinates is presented. GRA

**N76-16701#** Aerospace Corp., El Segundo, Calif. Space Physics Lab.
**PRECIPITATION OF PARTICLES AT LOW AND MIDDLE LATITUDES**
George A. Paulikas 1 Aug. 1975 111 p refs
(Contract F04701-75-C-0076)
(AD-A014820; TR-0076(6260-20)-3; SAMSO-TR-75-213) Avail: NTIS CSCL 04/1

The phenomenology and aeronomic effects of charged particle precipitation at middle and low latitudes are reviewed. This paper includes discussions of the behavior of quasi-trapped electrons observed at middle and low latitudes, the precipitation of protons from the ring current into the low latitude atmosphere, and a summary of the effects of the South Atlantic magnetic anomaly on charged particles trapped at low altitudes. A brief summary and review of controversial observations of charged particle fluxes at low altitudes is also included. Author (GRA)

# 47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

**N76-16702#** World Meteorological Organization, Geneva (Switzerland).
**REPORT OF THE MEETING OF EXPERTS FOR THE DEVELOPMENT OF A DATA MANAGEMENT PLAN FOR THE FGGE Global Atmospheric Research Programme**
1975 56 p Meeting held in Washington, 7-11 Apr. 1975
(GARP-Spec-Rept-16) Avail: NTIS HC $4.50; WMO, Geneva

The overall principle for the FGGE data management system and definitions of the data levels are given, followed by a description of the observing system comprising the WWW GOS, and land-space-and ocean-based sub-systems. The collection of observational data and the production of level II and III data sets are discussed together with the archiving of the data sets and their later availability from the WDCs. Conclusions and recommendations concerning data collection, data set production and archiving are presented. ESA

**N76-16703#** World Meteorological Organization, Geneva (Switzerland).
**REPORT ON THE FIELD PHASE OF THE GARP ATLANTIC TROPICAL EXPERIMENT. AIRCRAFT MISSION SUMMARY**
C. J. M. Aanensen, comp. Jul. 1975 154 p Prepared jointly with Intern. Council of Sci. Unions
(GATE-18) Avail: NTIS HC $6.75; WMO, Geneva

A summary of GATE aircraft missions giving outline details of each mission necessary to indicate possible use of each mission in any chosen investigation is given. Both investigated missions and aircraft intercomparisons are included together with details of daily aircraft tracks, type of mission, and cloud distribution on each flight. ESA

**N76-16704#** World Meteorological Organization, Geneva (Switzerland).
**WORLD WEATHER WATCH: THE PLAN AND IMPLEMENTATION PROGRAMME, 1976 - 1979**
Jul. 1975 58 p
(WMO-418; ISBN-92-63-10418-2) Avail: NTIS HC $4.50; WMO, Geneva

The purpose and basic concepts of the World Weather Watch (WWW) are outlined by a description of its essential elements. These include the Global Observatory System, the Global Data Processing System, and the Global Telecommunications System. The purpose, principles, and goals of these elements are given together with details of their organization, function, and basic tasks. Resolutions relating to the monitoring and operation of the WWW and the utilization of the WMD VAP are also included. ESA

**N76-16705#** Danish Meteorological Inst., Copenhagen.
**AN OPERATIONAL SPECTRAL SEMI-IMPLICIT ONELAYER MODEL**
B. P. Byrnak 1975 51 p refs
(DMI-Medd-25; ISBN-87-7478-105-7) Avail: NTIS HC $4.50

The computing time for spectral models related to numerical weather forecasting spectral transform methods was estimated for the RC 4000. The hypothesis was that a spectral hemispheric 3 or 5-level model could possibly be made fast enough for operational implementation. Therefore, a one level model was made operational, and its computing time measured. The result of the experiment also contains elementary theory for representation of meteorological variables in terms of spherical harmonics. ESA

**N76-16706#** Royal Netherlands Meteorological Inst., De Bilt.
**THE USE OF WIND PERSISTENCE DATA FOR THE CALCULATION OF CONCENTRATION STATISTICS [HET GEBRUIK VAN WINDPERSISTENTIEGEGEVENS VOOR HET BEREKENEN VAN KONCENTRATIESTATISTIEKEN]**
F. T. M. Nieuwstadt 1975 41 p refs Partly in ENGLISH and partly in DUTCH; ENGLISH summary
(KNMI-WR-75-9) Avail: NTIS HC $4.00

A method was developed, based on the Gaussian plume model, for the calculation of the frequency distribution of concentrations taking account of wind persistence. This method is applied to nuclear reactors for zoning purposes. ESA

**N76-16707#** Institut Royal Meteorologique de Belgique, Brussels.
**AIR HUMIDITY IN BELGIUM. PART 5: THE MIXING RATIO [L'HUMIDITE DE L'AIR EN BELGIQUE. FASCICULE 5: LE RAPPORT DE MELANGE]**
A. Bodeux 1975 70 p In FRENCH and DUTCH
(Misc-Ser-B-34-Pt-5) Avail: NTIS HC $4.50

The air-moisture mixing ratio in Belgium is tabulated for various stations and various UT hours. Daily distributions are given at 3 hour intervals and for several values of the mixing

ratios. The normalized mixing ratio per month is given with the same time interval together with possible errors and standard deviations. The variation of the monthly normalized values with respect to the Uccle station are given together with absolute extreme values. ESA

**N76-16708*#** National Environmental Satellite Service, Washington, D.C.
**NIMBUS-5 SOUNDER DATA PROCESSING SYSTEM. PART 2: RESULTS**
W. L. Smith, H. M. Woolf, C. M. Hayden, and W. C. Shen Jul. 1975 110 p refs
(NASA Order S-70249-AG)
(NASA-CR-146089; NOAA-75082801-Pt-2; COM-75-11334/0; NOAA-TM-NESS-71-Pt-2) Avail: NTIS HC $5.50 CSCL 04B

The Nimbus-5 spacecraft carries infrared and microwave radiometers for sensing the temperature distribution of the atmosphere. Methods developed for obtaining temperature profiles from the combined set of infrared and microwave radiation measurements are described. Algorithms used to determine (a) vertical temperature and water vapor profiles, (b) cloud height, fractional coverage, and liquid water content, (c) surface temperature, and (d) total outgoing longwave radiation flux are described. Various meteorological results obtained from the application of the Nimbus-5 sounding data processing system during 1973 and 1974 are presented. GRA

**N76-16709#** Army Electronics Command, Fort Monmouth, N.J.
**AN IMPROVED ALGORITHM FOR THE ITERATED MINIMAL INFORMATION SOLUTION FOR REMOTE SOUNDING OF TEMPERATURE**
Louis D. Duncan Aug. 1975 26 p refs
(DA Proj. 1T1-62111-AH-71)
(AD-A014885; ECOM-5571) Avail: NTIS CSCL 04/2

It is shown that the iterated minimal information solution of the radiative transfer equation for temperature profiles can be implemented to any prespecified number of iterations as a one-step solution by using a properly modified solution matrix. The mathematical derivation of the modified solution matrix is presented. It is shown that the limiting solution, as the iteration step number approaches infinity, exists; the solution matrix for the limit solution is derived and discussed. Numerical results are presented to show that the solution matrix for the iterated solution converges rapidly to the matrix of the limit solution. Results from temperature retrievals are presented which show (1) the iterated temperature solution converges rapidly to the temperature profile obtained from the limit solution matrix, and (2) the limit solution does not appear to contain any undesirable noise propagation. Author (GRA)

**N76-16710#** Army Electronics Command, Fort Monmouth, N.J.
**CROSSWIND MEASUREMENTS THROUGH PATTERN RECOGNITION TECHNIQUES**
Fredrick J. Taylor, Jack Smith, and Thomas H. Pries Jul. 1975 45 p refs
(DA Proj. 1T1-61102-B-53A)
(AD-A014882; ECOM-5569) Avail: NTIS CSCL 04/2

Optical devices currently used for crosswind measurements are calibrated and results interpreted on the basis of theoretical predictions. However, under strong turbulence conditions, the experimental observations do not compare well with the theoretical predictions. This deficiency can be overcome by use of a learning machine which utilizes a pattern recognition technique. Basically this approach substitutes observed experience for a detailed knowledge of the physical model. The technique utilizes a minicomputer to process observed spectral profiles. In the training phase, spectral features, which are weakly intercorrelated but strongly correlated with the crosswind, are selected and classified with known winds. These data are stored in the machine. During the execution phase, the observed spectral features are compared with the previously stored classification to yield a best estimate of the crosswind. Experimental results are presented which quantify the performance of this method. Author (GRA)

**N76-16711#** Lower Mississippi River Forecast Center, Slidell, La.
**THE USE OF A MULTIZONE HYDROLOGIC MODEL WITH DISTRIBUTED RAINFALL AND DISTRIBUTED PARAMETERS IN THE NATIONAL WEATHER SERVICE RIVER FORECAST SYSTEM**
David G. Morris Aug. 1975 21 p refs
(COM-75-11361/3; NOAA-TM-NWS-HYDRO-25) Avail: NTIS HC $3.50 CSCL 08H

Tests were conducted on a basin with a less-than-optimum rain gage network to evaluate the possibility of improving streamflow simulation through the use of zonal precipitation input and zonally varied parameters. Preliminary results for the 959 square mile, 4-zone watershed indicate that improved hydrograph reconstitution is obtained for rises caused by convective rains where the model parameters are adjusted to reflect hydrologic differences between upstream and downstream zones. The multizone approach used is model independent and should be valid for any conceptual hydrologic model employing a unit hydrograph to define the temporal distribution of runoff volumes. GRA

**N76-16712#** National Hurricane Center, Coral Gables, Fla.
**A STATISTICAL STUDY OF TROPICAL CYCLONE POSITIONING ERRORS WITH ECONOMIC APPLICATIONS**
Charles J. Neumann Mar. 1975 26 p refs
(COM-75-11362/1; NOAA-TM-NWS-SR-82; NOAA-75090301) Avail: NTIS HC $4.00 CSCL 04B

Hurricane landfall forecasts are based heavily on the latest available motion vector and position of a storm. Inaccuracies in these data are closely related to errors in the time and place of storm landfall. A Monte Carlo simulation of hurricane positioning errors is used to determine a statistical relationship between positioning errors and landfall errors. It is shown that for a typical 18-hour landfall forecast, approximately 22 percent of the landfall position error can be attributed to initial data uncertainties. It is further shown that a 20 percent increase in the size of a hurricane warning zone can be expected if the currently observed positioning errors are increased an average of 10 nmi. However, a 10 nmi decrease in positioning error yields only an 11 percent decrease in the size of the warning area. An economic analysis of potential changes in the size of hurricane warning areas is also shown. It is estimated that protection costs for a typical 300 nmi Gulf of Mexico coastal hurricane warning zone total $25.1 million. GRA

**N76-16713#** Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
**THEORETICAL STUDY OF VORTEX BREAKDOWN IN TORNADO-LIKE VORTICES Final Report**
O. R. Burggraf and M. R. Foster Jun. 1975 61 p refs
(Grant NOAA-04-3-022-37)
(COM-75-11345/6; NOAA-75082607) Avail: NTIS HC $4.50 CSCL 04B

Observations of mature tornadoes indicate that a 'bulge' often forms on the visible core just prior to withdrawal of the funnel from the ground. Laboratory experiments indicate that this bulge corresponds to a phenomenon called vortex breakdown, in which a bubble of reversed flow forms on the axis of the tornado vortex. In this study, the quasi-cylindrical equations for a tornado-like vortex jet are considered in order to clarify conditions under which the solution will breakdown at a finite height or continue indefinitely. It was found that breakdown occurs when the effective axial momentum flux (flow force) is less than a critical value; for higher values of flow force, the solution continues indefinitely, with Long's (1961) similarity solution as terminal state. When applied to the conditions of the 1957 Dallas tornado, the computed breakdown location is in conformity with Hoecker's analysis of the observations. GRA

**N76-16714#** National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
**OPEN SESAME, SEVERE ENVIRONMENTAL STORMS AND MESOSCALE EXPERIMENT**
D. K. Lilly Jun. 1975 497 p refs Proc. of the Opening Meeting, Boulder, Colo., 4-6 Sep. 1974
(COM-75-11394/4) Avail: NTIS HC $12.50 CSCL 04B

The report is a record of the proceedings of the SESAME (Severe Environmental Storms And Mesoscale Experiment) opening meeting held at Boulder, Colorado on September 4-6,

1974. The meeting was held to acquaint the meteorological research community with the existence and scope of a planned research project, the Severe Environmental Storms and Mesoscale Experiment (SESAME), and to solicit the community's advice and participation. Some of the areas discussed and examined in this report are: the NOAA Observational Program, Vertical Sounding problems and solutions, SESAME Data management, the Severe Storm environment, the Boundary Layer, Mescoscale Modeling, Cloud and Severe Storm Modeling, Recent Severe Storm and Tornado Observations, Dissents and Additions, and Management Plan and University. Also included are the results of the SESAME questionnaire that was distributed at the meeting. GRA

**N76-16715#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.

**COMPARISON OF STRATEGIES IN NUMERICAL INTEGRATION OF A NONLINEAR ADVECTION EQUATION Environmental Research Papers**

Ralph Shapiro 15 Apr. 1975 50 p refs
(AF Proj. 8604)
(AD-A014775; AFCRL-TR-75-0212; AFCRL-ERP-504) Avail: NTIS CSCL 04/2

The simple, nonlinear time-dependent advection equation delta u/delta t times delta u/delta x G, in which the dependent variable u (which may be considered a velocity) is a function of time (t), and one space dimension (x) is used as a framework for the comparison of a number of computational strategies. Second and fourth order schemes, with differing boundary conditions, are examined and compared with an analytical solution. Author

**N76-16716#** Naval Postgraduate School, Monterey, Calif.

**OCEAN HYDROCLIMATE, ITS INFLUENCE ON CLIMATE M.S. Thesis**

Donald Gene Buchanan Sep. 1975 227 p refs
(AD-A014635) Avail: NTIS CSCL 04/2

The statistical synthesis of selected oceanographic parameters (Sea Surface Temperature or SST, SST anomalies, boundary heat exchanges, etc.) over a specified period of time at a given place or over a given area is defined as ocean 'Hydroclimate'. Oceanic influence on atmospheric climate is described. In particular, the ocean's role within the earth's hydrologic cycle and heat budget is explained through hydrospheric, lithospheric, and atmospheric interactions, as related to SST distributions, ocean currents, upwelling, sea-breezes, and monsoons. SST anomalies as a cause of short period climatic variations are examined. The deep-sea sediment record of past SST conditions is shown to indicate past effects of the ocean on climate. A previously defined numerical index describing oceanicity, a quantitative measure of the ocean's effect on climate, is reviewed. An evaluation of hydroclimatic sources most useful to meteorologists was prepared and includes a categorized list and individual evaluations of 62 hydroclimatic products. GRA

**N76-16717#** Mount Auburn Research Associates, Inc., Newton Upper Falls, Mass.

**EFFECTS OF AIRPLANE FLOWFIELDS ON CLOUD WATER CONTENT MEASUREMENTS Final Report, 19 Sep. 1974 - 30 Apr. 1975**

Hillyer G. Norment 30 Apr. 1975 82 p refs
(Contract F19628-75-C-0053; AF Proj. 7605)
(AD-A014807; AFCRL-TR-75-0231) Avail: NTIS CSCL 04/2

Hydrometeor concentrations seen by fuselage-mounted particle measurement instruments are distorted owing to flow around the airplane. A general, three-dimensional method is used to compute flow-caused concentration distortion for specific sampling sites on two C130 cloud physics research airplanes. Results are presented for a variety of hydrometeor types (rain, snow and ice) over broad ranges of particle size. GRA

**N76-16718#** Florida State Univ., Tallahassee. Dept. of Statistics.

**THE POISSON DISTRIBUTION FOR THE FREQUENCY OF RARE LEVELS OF PERSISTENT METEOROLOGICAL ELEMENTS**

R. J. Serfling Jun. 1975 18 p refs
(Contract N00014-67-A-0235-0006)
(AD-A014717; FSU-Statistics-M345; TR-96-ONR) Avail: NTIS CSCL 04/2

Statistical models for meteorological phenomena typically break down at the extremes. For example, the day-to-day rainfall at a location in a given month may be modeled as a Markov process with effective determination of model parameters for a broad range of rainfall categories up to but excluding that of unusually high precipitation. Current techniques of modeling and estimation are somewhat inadequate for determination of quantities such as the probability that a specified extreme level of precipitation will occur at least three times in a given month, and the probability that the extreme level will not occur two days in succession during a given month. This paper delineates the role of the Poisson distribution in approximating such probabilities. The Poisson approximation is shown to be applicable under considerable relaxation of the classical independence assumption, which is inappropriate in meteorology due to the tendency of weather elements such as temperature, atmospheric pressure, and rainfall to 'persist'. Exact bounds on the error of approximation are derived under general conditions, and special attention is given to the case of Markov dependence. Some numerical illustration is provided. GRA

**N76-16719#** Purdue Univ., Lafayette, Ind. Water Resources Research Center.

**THE STOCHASTIC AND CHRONOLOGIC STRUCTURE OF RAINFALL SEQUENCES. APPLICATION TO INDIANA Final Report, Sep. 1971 - Aug. 1975**

M. Levent Kavvas and Jacques W. Delleur Aug. 1975 218 p refs Sponsored by Interior Dept.
(PB-245257/1; TR-57; W75-11854; OWRT-B-036-IND(10)) Avail: NTIS HC $7.75 CSCL 04B

The point stochastic analysis of the daily rainfall occurrence in Indiana is considered along with the time series analysis of the monthly and the annual rainfall sequences at various stations in Central United States. There are cyclicites both in the first and second moments of the point stochastic process. Physically meaningful annual and 15-day cycles were found to be significant. There is a slight downward trend in the rate of daily occurrence in Indiana. The Neyman-Scott cluster process was constructed in the time dimension to model this physical persistence. In the time series analysis, a theoretical and empirical analysis of the removal of cyclicities was performed. A spectral and a variance-time analysis of the ARIMA family of the hydrologic time series models was done to study their long range dependence characteristics. GRA

# 48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

**N76-16720#** Joint Publications Research Service, Arlington, Va.

**OCEAN AS A DYNAMIC SYSTEM**

V. I. Lebedev, T. A. Ayzatullin, and K. M. Khaylov 15 Jan. 1976 58 p refs Transl. into ENGLISH of the book "Okean kak Dinamicheskaya Sistema" Leningrad, 1974 p 4-5; 139-204
(JPRS-66593) Avail: NTIS HC $4.50

The ocean is described as an integral dynamic system with physical, chemical, and biological elements. Therefore it requires treatment as an integral animate system in its study and use. The operation of this complex system is discussed under the self-regulation mechanisms maintaining its equilibrium and its stability with regard to external effects. Author

**N76-16721*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**DESIGN, FABRICATION AND SYSTEMS INTEGRATION OF A SATELLITE TRACKED, FREE-DRIFTING OCEAN DATA BUOY**

John W. Wallace and John W. Cox Jan. 1976 24 p refs
(NASA-TM-X-72817) Avail: NTIS HC $3.50 CSCL 08C

Engineering details are presented of a small free-drifting buoy configuration designed for use in the study of continental shelf water circulation patterns in the Chesapeake Bight of the Western

North Atlantic Ocean. The buoy incoporated French instrumentation and was interrogated by the French EOLE satellite to provide position and four channels of temperature data. The buoy design included a variable depth drogue and a power supply sufficient for six weeks of continuous operations. Proof tests of the configuration indicated an adequate design and subsequent field experiments verified the proper functioning of the system.Author

**N76-16722#** World Meteorological Organization, Geneva (Switzerland).
**NORTH ATLANTIC OCEAN STATIONS VESSEL MANUAL**
1975 26 p
(WMO-414; ISBN-92-63-10414-X) Avail: NTIS HC $4.00; WMO, Geneva

The manual provides guidance on the procedures to be followed over the whole range of primary, secondary and other services from the time an ocean vessel leaves its base until it returns. Other aspects covered include telecommunications and safety. ESA

**N76-16723#** Woods Hole Oceanographic Institution, Mass.
**MOORING OPERATIONS OF THE WOODS HOLE BUOY GROUP FOR THE MID-OCEAN DYNAMICS EXPERIMENT**
Robert H. Heinmiller, Jr. Sep. 1975 117 p refs
(Contract N00014-74-C-0262; Grant NSF GX-29054; NR Proj. 083-004)
(AD-A014876; WHOI-75-42; NSF/IDOE-75-304) Avail: NTIS CSCL 08/3

The Moored Array Project (Buoy Group) at the Woods Hole Oceanographic Institution carried out a series of moored-array experiments to measure currents and temperatures as part of the Mid-Ocean Dynamics Experiment (MODE). During the period from October, 1971 to August, 1974, a total of forty-four moorings were deployed. This report summarizes the design, preparation, and field operations involved in the deployment and recovery of these arrays. Tabulations are included of all moorings set. GRA

**N76-16724#** Naval Oceanographic Office, Washington, D.C.
**BASIC ACOUSTIC OCEANOGRAPHY Final Report**
Morris Schulking Apr. 1975 84 p refs
(AD-A014720; NOO-RP-1) Avail: NTIS CSCL 08/10

A brief introduction is given of oceanography for acousticians. The main topics and related acoustical examples are: Submarine geology (bottom acoustic loss); marine biology (the deep sound scattering layer); chemical and physical properties of seawater (sound speed and sound absorption); the steady state of the ocean (sound speed vs depth structure and modes of sound propagation in the ocean); and waves in the ocean (sea surface loss and sea surface noise, and acoustic propagation and internal waves). GRA

**N76-16725#** Woods Hole Oceanographic Institution, Mass.
**THE CONTINENTAL MARGIN OFF WESTERN AFRICA: ANGOLA TO SIERRA LEONE**
K. O. Emery, Elazar Uchupi, Joseph Phillips, and Carl Bowin Dec. 1974 159 p refs
(Grant NSF GX-28193)
(PB-245408/0; WHOI-74-99; NSF/IDOE-75-54) Avail: NTIS HC $6.75 CSCL 08J

About 30,750 line km of geophysical traverses (seismic reflection and refraction, magnetics, and gravity) were made in the Gulf of Guinea and vicinity aboard R/V ATLANTIS II during 1972 and 1973. These traverses, supplemented by about 50,000 line km of previous ones by other ships, provide a basis for mapping and understanding the geological structure, history and origin of the region. The deep indentation of the outline of western Africa is paralleled by a similar bend of the Mid-Atlantic Ridge, and by the prominent bulge of northeastern Brazil. These sharp bends are due to left-lateral offsets by numerous transform faults in a belt of equatorial fracture zones. GRA

**N76-16726#** Virginia Inst. of Marine Science, Gloucester Point.
**BATHYMETRIC COMPARISONS: A MANUAL OF METHODOLOGY, ERROR CRITERIA AND TECHNIQUES**
A. H. Sallenger, Jr., V. Goldsmith, and C. H. Sutton Jul. 1975 81 p refs
(Grant NOAA-04-5-158-49)
(COM-75-11385/2; VIMS-SRAMSOE-66; NOAA-75091707) Avail: NTIS HC $5.00 CSCL 08J

Methods are considered by which bathymetric comparisons can be conducted to consider various aspects of accuracy criteria for soundings, and to discuss the use of methods and error criteria in specific applications. Topics discussed include: (1) data point comparison, (2) contour overlay method, (3) data point-grid point comparison, and (4) grid point comparison. Bathymetric data sources for the U.S. coastal waters (NOAA and U.S. Army Corps of Engineers) are analyzed in terms of the accuracy of soundings published by each source. Sediment budget studies, analyses of mobility of subaqueous features, bathymetric stability for design criteria and mineral deposit exploration, and other applications of the techniques of bathymetric comparisons are included. GRA

**N76-16727#** Research Triangle Inst., Research Triangle Park, N.C.
**QUASI REALTIME OCEANOGRAPHIC EXPERIMENT USING NOAA SATELLITE DATA AND SHIP DATA Final Report**
Fred M. Vukovich Feb. 1975 65 p refs
(Grant NOAA-3-35402)
(COM-75-11356/3; NOAA-75082803) Avail: NTIS HC $4.50 CSCL 08C

A series of oceanographic studies was performed off the southeast coast of the United States, combining data from the NOAA-2 and NOAA-3 satellite and from the Cape Fear Technical Institute, R/V DALLAS HERRING and R/V ADVANCE II. The phenomena studied consisted of short-period intrusions of shelf water into the Gulf Stream and a cold eddy on the east side of the Gulf Stream. The satellite data were used to identify and locate these perturbations in realtime, and to define the sea surface temperature distribution associated with the perturbations. The results demonstrated that the NOAA satellite data may be used (1) to locate significant oceanic perturbations and (2) to aid in the study of the structure of perturbations by integrating in situ data with the satellite infrared data. GRA

**N76-16728#** TRW Systems Group, Redondo Beach, Calif.
**OCEAN FLIGHT TEST Final Report**
O. W. Momary 9 Jun. 1975 53 p refs
(Contract NOAA-3-35425)
(COM-75-11346/4; NOAA-75090202) Avail: NTIS HC $4.50 CSCL 08A

Aircraft overflights were made over coastal waters off Southern California in early 1975 and the results of that research are presented. As an indication of 'apparent' productivity of the water, a comparison was made of the ratio of reflected energy at selected wavelengths to that obtained from a standard source of reflectance. The flight test results indicate that such a comparison yields an increase in the ratio with increasing distance from land. This trend implies increasing absorption of solar energy near 6800 A as one approaches the land mass. Overall results, however, indicate that a measurable quantitative change in backscattered solar energy at discrete wavelength within the region of interest does not appear technically feasible, probably due to the very high absorption of water at the longer wavelengths. GRA

## 51 LIFE SCIENCES (GENERAL)

Includes genetics.

**N76-16729** Saskatchewan Univ., Saskatoon.
**PRODUCTION AND CHARACTERIZATION OF ENZYMES STABILIZED AS HUMIC ACID ANALOGUES Ph.D. Thesis**
Michael John Rowell 1974 178 p
Avail: Univ. Microfilms Order No. 76-738

Mechanisms for the incorporation of enzymes into humic constituents and their stabilization in soil were studied using model systems. Water-soluble (S-BQ) and water-insoluble (I-BQ) enzyme derivatives were produced by the reaction of p-benzoquinone and trypsin, pronase, papain, subtilisin, acid phosphatase, carboxypeptidase A and urease. Yield of derivative, nitrogen content and the retention of activity varied depending upon the reaction pH, amount of each constituent added, type of complex and the specific enzyme involved. Lyophilization reduced the

activity of most enzyme derivatives. Generally, enzyme complexes were considerably more stable at high temperatures than the free enzyme. Enzymic characteristics such as pH activity and stability, temperature optimal, and kinetic constants were often markedly different from those of the free enzyme. Steric effects were also evident. Dissert. Abstr.

**N76-16730#** Joint Publications Research Service, Arlington, Va.
**SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 9, NO. 5, 1975**
17 Dec. 1975 159 p refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 (JPRS-66404) Avail: NTIS HC $6.75

The report contains articles concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the man-spaceship system; space psychology and physiology; and environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) For individual titles, see N76-16731 through N76-16739.

**N76-16731** Joint Publications Research Service, Arlington, Va.
**OXYGEN EXCHANGE IN THE BODY ACCOMPANYING REPLACEMENT OF ATMOSPHERIC NITROGEN BY HELIUM** **c52**
G. V. Troshikhin, L. A. Isaakyan, and G. G. Bekirova *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 13-20 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 10-14 (For availability see N76-16730 07-51)

Total gas exchange, body temperature, content of free oxygen in the quadriceps muscle and its changes upon oxygen inhalation of a known dosage (oxygen test) were measured using Wistar rats during their one-hour exposure to a helium-oxygen atmosphere (21%) at 25 C. In this atmosphere the animals exhibited a 1.8 deg dropoff of body temperature, a 20.5% increase in gas exchange and a 26% decrease in oxygen in muscle tissue in comparison with the corresponding parameters in the air. After the experiment, during the first 10-minute exposure to a normal atmosphere the oxygen tests were 10-15% lower than before the experiment. These findings give evidence of an increase in oxygen exchange in the muscles of animals exposed to a helium-oxygen atmosphere at a temperature below a comfortable level. Author

**N76-16732** Joint Publications Research Service, Arlington, Va.
**RESTRUCTURING OF THE HUMAN TEMPERATURE RHYTHM AFTER INVERSION OF THE RHYTHM OF LIFE IN ISOLATION** **c52**
S. I. Stepanova and S. P. Kukishev *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 57-69 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 35-44 (For availability see N76-16730 07-51)

The diurnal dynamics of body temperature of four male test subjects was studied before and after inversion of their sleep-wakefulness cycle in an isolation chamber. One subject exhibited restructuring of the temperature rhythm in accordance with the new cycle which was completed by the 11th day of confined life. The other test subjects exhibited only a partial adaptation of body temperature to the new sleep-wakefulness cycle during the 34-day experiment. Author

**N76-16733** Joint Publications Research Service, Arlington, Va.
**CORRELATION BETWEEN THE AUTOMONIC COMPONENTS OF THE ORIENTATION REACTION AND THE NATURE OF THE INFORMATION RECEIVED BY AN AIRMAN** **c53**
R. I. Brusnichkina *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 78-85 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 49-54 (For availability see N76-16730 07-51)

The influence of the pattern of the information (certainty and significance) which reaches a pilot on the physiological parameters of his orientation reaction (skin-galvanic reflex, heart rate, electromyograph) was examined. Two experimental series, on a simulation stand and in real flight, were carried out; collected data show that the pattern of the orientation reaction is related to the information certainty and significance. The responses of physiological parameters to significant elements of the situation are shown to be phasic. Author

**N76-16734** Joint Publications Research Service, Arlington, Va.
**COLOR PERCEPTION AFTER INTENSIVE PHOTOSTIMULATION** **c53**
V. I. Shostak *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 92-97 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 57-60 (For availability see N76-16730 07-51)

After a monocular effect of short-term intensive light stimulation (80 micro sec in duration with an illuminance of 1,600 candle/sec) which followed complete adaptation to the darkness, test subjects exhibited color perception disorders. These included a decrease in the acuity of color discrimination measured with the AN-59 anomaloscope and significant distortion of the subjective evaluation of different color stimuli. The spectrum of an experimental intensive light effect was varied; it was thus shown that color perception disorders were associated with a nonuniform decrease in the sensitivity of color perception systems. The pattern and duration of these disturbances were dependent on the spectral composition and intensity of the light stimulus. Author

**N76-16735** Joint Publications Research Service, Arlington, Va.
**GAS EXCHANGE DURING HYPERCAPNIA UNDER CONDITIONS OF DIFFERENT OXYGEN CONTENT** **c52**
V. P. Zagryadskiy and Z. K. Sulimo-Samuyllo *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 98-105 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 61-65 (For availability see N76-16730 07-51)

During the slow development of a hypercapnic state aggravated by a lowered oxygen content in the breathing air the oxygen supply of the human body decreases noticeably. This occurs at rest as well. An increase in the oxygen content in the breathing air to 20-22% alleviates the adverse hypercapnic effect and therefore improves gas exchange parameters. Author

**N76-16736** Joint Publications Research Service, Arlington, Va.
**SENSORY AND MOTOR COMPONENTS OF EYE FIXATION MOVEMENT DURING EXPOSURE TO ANGULAR ACCELERATIONS** **c53**
V. I. Babiyak *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 106-113 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 66-70 (For availability see N76-16730 07-51)

The effect of angular accelerations on the eye fixation function and concomitant sensory reactions was investigated under special conditions. An illusion of target distortion toward the rapid component of vestibular nystagmus developed in these situations. Changes in eye fixation movements and sensation of target were coordinated and depended on the direction of the vestibular nystagmus. The findings indicate that during an exposure to angular accelerations the stability of target perceptions is disturbed and objectively recorded errors of its fixation by the optic apparatus are made. Author

**N76-16737** Joint Publications Research Service, Arlington, Va.
**CHANGES IN THE INDUCED POTENTIAL IN MAN DURING ALTITUDE DECOMPRESSION** **c52**
A. A. Antonov *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 114-121 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 71-75 (For availability see N76-16730 07-51)

In order to evaluate the functional state of the central nervous system during altitude decompression the method of recording the induced potential to a light stimulus was used. Changes in the latent periods and energies of induced potential waves were noted during different decompression regimes. It therefore was concluded that the functional state of the central nervous system

changes before bends; during bends it changes more significantly. The response to a short-term effect of painless decompression and to painful symptoms of the disease is different. Author

**N76-16738** Joint Publications Research Service, Arlington, Va.
**INCREASING THE HEAT TOLERANCE OF THE HUMAN BODY BY MUSCLE CONDITIONING** **c52**
F. T. Agarkov and A. S. Pavlov *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 122-129 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 75-80 (For availability see N76-16730 07-51)

Experiments carried out with 129 athletes (gymnasts, weightlifters and boxers) and 153 nonathletes demonstrated that sports training considerably increases the general and specific physical performance and elevates by a factor of 2-2.5 human tolerance to thermal effects. The relationship between the signs of physical fitness of athletes and the levels of their tolerance to heat was established. The procedure for evaluating the thermal tolerance of man was developed, together with a scale for its evaluation. Author

**N76-16739** Joint Publications Research Service, Arlington, Va.
**CHANGE IN HEMOGLOBIN MASS DURING PROLONGED HYPOKINESIA** **c52**
R. K. Kiselev, R. S. Balakhovskiy, and O. A. Virovets *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 130-136 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 80-84 (For availability see N76-16730 07-51)

Total hemoglobin mass was measured by the carbon dioxide method in 33 test subjects, 21 of whom were exposed to 30-day bedrest and six of whom were exposed to 100-day bedrest. The hypokinetic test subjects exhibited a decrease in hemoglobin mass by 11-24%. During readaptation the test subjects who had a noticeable reduction of homoglobin exhibited an increase in the reticulocyte count by a factor of 2.7. It is postulated that the decrease in gravity during bedrest and antiorthostatic hypokinesia results in a reduced rate of hemoglobin synthesis in the bone marrow. Author

**N76-16740*#** Scientific Translation Service, Santa Barbara, Calif.
**GEOTROPIC REACTION OF PLANTS**
A. I. Merkis Washington NASA Jan. 1976 316 p refs Transl. into ENGLISH of the book "Geotropicheskaya Reaktsiya Rasteniy" Vilnyus, Mintis Press, 1973 p 1-261
(Contract NASw-2791)
(NASA-TT-F-16826) Avail: NTIS HC $9.75 CSCL 06C

Data on the physiology (auxins, amino acids, and other metabolites) of the geotropic reaction of plants is presented. Systems of perception and fixation of the geotropic stimulus are examined, as in the response phase of geotropic bending. The text is a manual for a wide range of physiologists and specialists concerned with problems of gravitational effects in plants. Crop lodging in wheat was specifically studied. Author

**N76-16741*#** Scientific Translation Service, Santa Barbara, Calif.
**SPACE-EARTH FORECASTS**
I. P. Druzhinin Washington NASA Dec. 1975 302 p refs Transl. into ENGLISH of the book "Kosmos-Zemlya. Prognozy" Moscow, Mysl Press, 1974 p 1-288
(Contract NASw-2791)
(NASA-TT-F-16375) Avail: NTIS HC $9.75 CSCL 08D

Concepts of the effect of space phenomena on terrestrial processes (in the U.S.S.R.) are presented. Ways and methods of predicting the course of natural phenomena on the basis of cosmic data are examined. Topics discussed include: (1) economic benefits to the Soviet Union; (2) weather forecasting; (3) crop forecasting; (4) solar activity effects on populations of plants and animals; and (5) solar activity effects on human disease cycles. Author

**N76-16742*#** Joint Publications Research Service, Arlington, Va.
**MICROORGANISMS IN THE STRATOSPHERE**
A. A. Imshenetskiy, S. V. Lysenko, and G. A. Kazakov Washington NASA Feb. 1976 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 224, no. 1, 1975 p 223-225
(NASA Order W-13183)
(NASA-TT-F-16872) Avail: NTIS HC $3.50 CSCL 06C

Microbiological analyses of the stratosphere by meteorological rockets carrying sampling devices are reported. Among colonies of microorganisms, the microscopic fungi Circinelle muscae, Penicillium, Aspergillus niger, and Mycelia sterilia were found. In addition, a culture of microbacteria and micrococcus was detected that formed yellow-orange and white colonies on dense nutrient media. G.G.

# 52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

**N76-16743*** + National Aeronautics and Space Administration, Washington, D.C.
**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 148, DECEMBER 1975**
Dec. 1975 81 p refs
(NASA-SP-7011(148)) Avail: NTIS HC $5.00 CSCL 06E

This bibliography lists 245 reports, articles, and other documents introduced into the NASA scientific and technical information system in November 1975. Author

**N76-16744#** Royal Aircraft Establishment, Farnborough (England).
**VERTEBRAL FRACTURES IN PILOTS INVOLVED IN HELICOPTER ACCIDENTS**
P. Italiano Sep. 1975 21 p refs Transl. into ENGLISH from Riv. Med. Aeronaut. Spaz. (Italy), v. 29, no. 4, 1966 p 577-602
(RAE-Lib-Trans-1854; BR49820) Avail: NTIS HC $3.50

After a survey of the most frequent causes of helicopter accidents, vertebral fractures which occurred during some of the accidents were considered. Vertebral fractures arising from helicopter accidents are located in the thoraco-lumbar junction. They show pecular radiological characteristics, depending upon their pathogenesis. In the cases considered, this always occurred during a drop of several meters to the ground and was facilitated by the slightly forward, titled position assumed by the pilot. The fatigue state of the pilot during flight was also considered, and it was determined that vibration is of particular importance. The following points are proposed to improve flight safety: (1) helicopters designed to reduce vibration, (2) seats which fit close to the pilot, take into account his flying position, and contain shock absorbers, and (3) psycho-physical tests to help determine an acceptable number of flying hours per day and a weekly rest period. Author

**N76-16745*#** Texas Inst. for Rehabilitation and Research, Houston. Biostereometrics Lab.
**STEREOMETRIC BODY VOLUME MEASUREMENT Final Report**
R. E. Herron 1975 61 p refs
(Contract NAS9-11604)
(NASA-CR-147399) Avail: NTIS HC $4.50 CSCL 06P

The following studies are reported: (1) effects of extended space flight on body form of Skylab astronauts using biostereometrics; (2) comparison of body volume determinations using hydrostatic weighing and biostereometrics; and (3) training of technicians in biostereometric principles and procedures. Author

**N76-16746*#** Naval Aerospace Medical Research Lab., Pensacola, Fla.
**NUCLEAR EMULSION MEASUREMENTS OF THE ASTRONAUTS' RADIATION EXPOSURES ON SKYLAB MISSIONS 2, 3, AND 4**
Hermann J. Schaefer and Jeremiah J. Sullivan 10 Dec. 1975 17 p refs
(NASA Order T-43310-G)
(NASA-CR-147436; NAMRL-1220) Avail: NTIS HC $3.50 CSCL 06R

On the Skylab missions, Ilford G.5 and K.2 emulsions were flown as part of passive dosimeter packs carried by the astronauts

on their wrists. Due to the long mission times, latent image fading and track crowing imposed limitations on a quantitative track and grain count analysis. For Skylab 2, the complete proton energy spectrum was determined within reasonable error limits. A combined mission dose equivalent of 2,490 millirems from protons, tissue stars and neutrons was measured on Skylab 2. A stationary emulsion stack, kept in a film vault drawer on the same mission, displayed a highly structured directional distribution of the fluence of low-energy protons (enders) reflecting the local shield distribution. On the 59 and 84-day mission 3 and 4, G.5 emulsions had to be cut on the microtom to 5-7 microns for microscopic examination. Even so, the short track segments in such thin layers precluded a statistically reliable grain count analysis. However, the K.2 emulsions still allowed accurate proton ender counts without special provisions. Author

**N76-16747*#** Kanner (Leo) Associates, Redwood City, Calif.
**SOME ASPECTS OF THE PROBLEM OF PREDICTING MAN'S HEALTH DURING A SPACE FLIGHT**
Yu. M. Svirezhev Washington NASA 12 Jan. 1976 86 p refs Transl. into ENGLISH of Conf. paper from Acad. of Sci. of the USSR, Moscow Presneted at the Sixth Conf. of the Sov.-Am. Working Group on Space Biol. and Med., 1975 p 1-78
(Contract NASw-2790)
(NASA-TT-F-16838) Avail: NTIS HC $5.00 CSCL 06S

The overall SISMEC prediction system and the goal of combining in it the advantages of expert prediction (knowledge and intuition of medical specialists) and mathematical prediction (rapid processing of much data and real time prediction) are described. Mathematical derivation and analysis of both purely mathematical and expert prediction models follows. Testing of numerous models against Soyuz, Salyut and Skylab data on cosmonaut physiological functions is presented in detail. Tolerance of LBNP is found to be predicted best from soft, partial LBNP tests, and further tests of some models are found necessary. Guidelines for joint Soviet-American development of the system are given. Author

**N76-16748*#** California Univ., Berkeley. White Mountain Research Station.
**IN VIVO MEASUREMENT OF HUMAN BODY COMPOSITION Semiannual Status Report, 1 Jan. - 30 Jun. 1975**
Nello Pace, Benjamin W. Grunbaum, Arthur M. Kodama, and David C. Price 30 Jun. 1975 67 p
(Grant NGR-05-003-470)
(NASA-CR-146223; SASR-6) Avail: NTIS HC $4.50 CSCL 06B

Physiological changes in human beings were studied during a 21 day bed rest regime. Results of blood analyses indicated clearly that major metabolic adjustments occurred during prolonged bed rest. However, urinary metabolic analyses showed variances attributed to specimen collection inaccuracies and the small number of test subjects. G.G.

**N76-16749*#** Old Dominion Univ. Research-Foundation, Norfolk, Va.
**DEVELOPMENT OF A DOSIMETER FOR DISTRIBUTED BODY ORGANS Progress Report, 31 May - 30 Nov. 1975**
Govind S. Khandelwal (Old Dominion Univ.) 26 Jan. 1976 35 p refs
(Grant NsG-1055)
(NASA-CR-146225) Avail: NTIS HC $4.00 CSCL 06R

Calculational methods for estimation of dose from external proton exposure of aribtrary convex bodies is briefly reviewed and all of the necessary information for the estimation of dose in soft tissue is presented. Special emphasis is on retaining the effects of nuclear reaction especially in relation to the dose equivalent. Author

**N76-16750*#** Joint Publications Research Service, Arlington, Va.
**PSYCHOLOGICAL PROBLEMS OF INTERPLANETARY FLIGHT**
A. A. Leonov and V. I. Lebedev Washington NASA Oct. 1975 238 p refs Transl. into ENGLISH of the book "Psikhologicheskiye Problemy Mezhplanetnogo Poleta" Moscow, Izd. Nauka, 1975 p 4-248
(NASA Order W-13183-197)
(NASA-TT-F-16536) Avail: NTIS HC $8.00 CSCL 16S

Psychological compatibility among crew members of an interplanetary ship is examined under the conditions of group isolation, the extended effect of weightlessness on human mental processes, the effect of sensory and information starvation on the appearance of unusual mental states, emotional stress, and the rhythm of working and rest. Author

**N76-16751*#** Organon Diagnostics, El Monte, Calif.
**MEMS REAGENT AND SAMPLE HANDLING PROCEDURE: FEASIBILITY OF VIRAL ANTIBODY DETECTION BY PASSIVE IMMUNE AGGLUTINATION Final Report, Jan. - Sep. 1975**
G. D. Bailey and H. J. Tenoso 1 Dec. 1975 81 p refs
(Contract NAS9-13672)
(NASA-CR-147398; Rept-115-F) Avail: NTIS HC $5.00 CSCL 06E

An attempt was made to develop a test requiring no preadsorption steps for the assessment of antibodies to rubella and mumps viruses using the passive immune agglutination (PIA) method. Both rubella and mumps antigens and antibodies were prepared. Direct PIA tests, using rubella antigen-coated beads, and indirect PIA tests, using rubella antibody-coated beads, were investigated. Attempts, using either method, were unsuccessful. Serum interference along with nonspecific agglutination of beads by the rubella antigen resulted in no specific response under the test conditions investigated. A new, highly sensitive approach, the enzyme immunoassay (EIA) test system, is recommended to overcome the nonspecificity. This system is a logical outgrowth of some of the solid phase work done on MEMS and represents the next generation tests system that can be directly applied to early disease detection and monitoring. Author

**N76-16752#** Interuniversitair Reactor Instituut, Delft (Netherlands).
**MEASUREMENTS OF THE DOSAGE RESULTING FROM BACKGROUND RADIATION IN BUILDINGS WITH A Ge(Li) DETECTOR [METINGEN MET EEN Ge(Li)-DETECTOR VAN DE DOSIS TENGEVOLGE VAN ACHTERGRONDSTRALING IN GEBOUWEN]**
J. A. Akkermans and C. Roodbergen [1974] 30 p refs In DUTCH
(IRI-190-74-03) Avail: NTIS HC $4.00

A method was developed by which the dosage rate of all gamma radiation of a nuclide can be determined from the gamma spectrum, measured with a Ge(Li) semiconductor detector or an NaJ(Tl) scintillation counter. The total dosage rate of a nuclide, including possible daughter products, was calculated from the surface of one photopeak in the gamma spectrum of the nuclide. This is based on calculated values for the percentage contribution of one gamma transition to the total dosage rate as a result of all gamma radiation emitted by the nuclide. A number of measurements were carried out with a Ge(Li) detector at various locations within a building. Individual contributions to the dosage rate of 40K, 226 Ra, and 232 Th were calculated. The dosage rate in rooms with concrete walls is about three times as high as in rooms with wooden walls. Author (ESA)

**N76-16753#** Interuniversitair Reactor Instituut, Delft (Netherlands).
**CONDENSATION OF WATER ON DRY SALT CRYSTALS. DESCRIPTION OF THE COMPUTER PROGRAM**
G. A. Ferron 16 Sep. 1975 21 p refs
(IRI-190-75-04) Avail: NTIS HC $3.50

A computer program for simulating the condensation of water vapor on dry salt crystals after entering the human respiratory system is described. The calculations are based on the quasi-stationary transport equations for mass and heat transfer. Both equations are corrected for the mean free path of the air molecules with the method described by Fuchs. Furthermore, the vapor pressure at the particle surface is corrected for salt dissolved in the particle liquid and the curvature of the particle surface. The calculations were carried out using an iteration process: at each step the mass of the particle increases with a part f of the mass of the particle; then the new quantities of the particles are calculated. Author (ESA)

**N76-16731** Joint Publications Research Service, Arlington, Va.
**OXYGEN EXCHANGE IN THE BODY ACCOMPANYING REPLACEMENT OF ATMOSPHERIC NITROGEN BY HELIUM**
G. V. Troshikhin, L. A. Isaakyan, and G. G. Bekirova *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 13-20 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 10-14 (For availability see N76-16730 07-51)

**N76-16732** Joint Publications Research Service, Arlington, Va.
**RESTRUCTURING OF THE HUMAN TEMPERATURE RHYTHM AFTER INVERSION OF THE RHYTHM OF LIFE IN ISOLATION**
S. I. Stepanova and S. P. Kukishev *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 57-69 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 35-44 (For availability see N76-16730 07-51)

**N76-16735** Joint Publications Research Service, Arlington, Va.
**GAS EXCHANGE DURING HYPERCAPNIA UNDER CONDITIONS OF DIFFERENT OXYGEN CONTENT**
V. P. Zagryadskiy and Z. K. Sulimo-Samuyllo *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 98-105 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 61-65 (For availability see N76-16730 07-51)

**N76-16737** Joint Publications Research Service, Arlington, Va.
**CHANGES IN THE INDUCED POTENTIAL IN MAN DURING ALTITUDE DECOMPRESSION**
A. A. Antonov *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 114-121 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 71-75 (For availability see N76-16730 07-51)

**N76-16738** Joint Publications Research Service, Arlington, Va.
**INCREASING THE HEAT TOLERANCE OF THE HUMAN BODY BY MUSCLE CONDITIONING**
F. T. Agarkov and A. S. Pavlov *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 122-129 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 75-80 (For availability see N76-16730 07-51)

**N76-16739** Joint Publications Research Service, Arlington, Va.
**CHANGE IN HEMOGLOBIN MASS DURING PROLONGED HYPOKINESIA**
R. K. Kiselev, R. S. Balakhovskiy, and O. A. Virovets *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 130-136 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 80-84 (For availability see N76-16730 07-51)

# 53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**N76-16754*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**THE 1975 RIDE QUALITY SYMPOSIUM**
Washington Nov. 1975 648 p refs Symp. held at Williamsburg, Va., 11-12 Aug. 1975; sponsored by NASA and DOT (NASA-TM-X-3295; DOT-TSC-OST-75-40; L-10448) Avail: NTIS HC $16.25 CSCL 05H

A compilation is presented of papers reported at the 1975 Ride Quality Symposium held in Williamsburg, Virginia, August 11-12, 1975. The symposium, jointly sponsored by NASA and the United States Department of Transportation, was held to provide a forum for determining the current state of the art relative to the technology base of ride quality information applicable to current and proposed transportation systems. Emphasis focused on passenger reactions to ride environment and on implications of these reactions to the design and operation of air, land, and water transportation systems acceptable to the traveling public. Papers are grouped in the following five categories: needs and uses for ride quality technology, vehicle environments and dynamics, investigative approaches and testing procedures, experimental ride quality studies, and ride quality modeling and criteria. For individual titles, see N76-16755 through N76-16780.

**N76-16755*** Boeing Co., Wichita, Kans.
**REVIEW OF RIDE QUALITY TECHNOLOGY NEEDS OF INDUSTRY AND USER GROUPS**
J. R. McKenzie and Stanley H. Brumaghim *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 5-30 refs (For availability see N76-16754 07-53)
(Contract NAS1-13908)
CSCL 05H

A broad survey of ride quality technology state-of-the-art and a review of user evaluation of this technology were conducted. During the study 17 users of ride quality technology in 10 organizations representing land, marine and air passenger transportation modes were interviewed. Interim results and conclusions of this effort are reported. Author

**N76-16756*** Mitre Corp., Bedford, Mass.
**RIDE QUALITY CRITERIA AND THE DESIGN PROCESS**
R. J. Ravera *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 31-43 refs (For availability see N76-16754 07-53)
CSCL 05H

Conceptual designs for advanced ground transportation systems often hinge on obtaining acceptable vehicle ride quality while attempting to keep the total guideway cost (initial and subsequent maintenance) as low as possible. Two ride quality standards used extensively in work sponsored by the U.S. Department of Transportation (DOT) are the DOT-Urban Tracked Air Cushion Vehicle (UTACV) standard and the International Standards Organization (ISO) reduced ride comfort criteria. These standards are reviewed and some of the deficiencies, which become apparent when trying to apply them in practice, are noted. Through the use of a digital simulation, the impact of each of these standards on an example design process is examined. It is shown that meeting the ISO specification for the particular vehicle/guideway case investigated is easier than meeting the UTACV standard. Author

**N76-16757*** Virginia Univ., Charlottesville.
**APPLICATION OF RIDE QUALITY TECHNOLOGY TO PREDICT RIDE SATISFACTION FOR COMMUTER-TYPE AIRCRAFT**
Ira D. Jacobson, A. R. Kuhlthau, and L. G. Richards *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 45-64 refs (For availability see N76-16754 07-53)
CSCL 05H

A method was developed to predict passenger satisfaction with the ride environment of a transportation vehicle. This method, a general approach, was applied to a commuter-type aircraft for illustrative purposes. The effect of terrain, altitude and seat location were examined. The method predicts the variation in passengers satisfied for any set of flight conditions. In addition several noncommuter aircraft were analyzed for comparison and other uses of the model described. The method has advantages for design, evaluation, and operating decisions. Author

**N76-16758*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**REVIEW OF MEASURED VIBRATION AND NOISE ENVIRONMENTS EXPERIENCED BY PASSENGERS IN AIRCRAFT AND IN GROUND TRANSPORTATION SYSTEMS**
David G. Stephens *In its* The 1975 Ride Quality Symp. Nov. 1975 p 65-85 refs (For availability see N76-16754 07-53)
CSCL 05H

Measured vibration and interior noise data are presented for a number of air and surface vehicles. Consideration is given to the importance of direction effects; of vehicle operations such as take-off, cruise, and landing; and of measurement location on the level and frequency of the measurements. Various physical

measurement units or descriptors are used to quantify and compare the data. Results suggest the range of vibration and noise associated with a particular mode of transportation and illustrate the comparative levels in terms of each of the descriptors. Collectively, the results form a data base which may be useful in assessing the ride of existing or future systems relative to vehicles in current operation. Author

**N76-16759*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**NONMOTION FACTORS WHICH CAN AFFECT RIDE QUALITY**
D. William Conner *In its* The 1975 Ride Quality Symp. Nov. 1975 p 87-96 refs (For availability see N76-16754 07-53)
CSCL 05H

Data pertaining to nonmotion factors affecting ride quality of transport aircraft were obtained as part of NASA in-house and sponsored research studies carried out onboard commuter-airline and research aircraft. From these data, quantitative effects on passenger discomfort of seat width, seat legroom, change in cabin pressure, and cabin noise are presented. Visual cue effects are also discussed. Author

**N76-16760*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**VEHICLE FOR CIVIL HELICOPTER RIDE QUALITY RESEARCH**
William J. Snyder and Ronald G. Schlegel (Sikorsky Aircraft) *In its* The 1975 Ride Quality Symp. Nov. 1975 p 97-116 refs (For availability see N76-16754 07-53)
CSCL 05H

A research aircraft for investigating the factors involved in civil helicopter operations was developed for NASA Langley Research Center. The aircraft is a reconfigured 17000 kg (36000 lb) military transport helicopter. The basic aircraft was reconfigured with advanced acoustic treatment, air-conditioning, and a 16-seat airline cabin. During the spring of 1975, the aircraft was flight tested to measure interior environment characteristics - noise and vibration - and was flown on 60 subjective flight missions with over 600 different subjects. Data flights established noise levels somewhat higher than expected, with a pure tone at 1400 Hz and vertical vibration levels between 0.07g and 0.17g. The noise and vibration levels were documented during subjective flight evaluations as being the primary source of discomfort. The aircraft will be utilized to document in detail the impact of various noise and vibration levels on passenger comfort during typical short-haul missions. Author

**N76-16761*** Boeing Vertol Co., Philadelphia, Pa.
**COMPUTER ANALYSIS OF RAILCAR VIBRATIONS**
Robert R. Vlaminck *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 117-140 (For availability see N76-16754 07-53)
CSCL 05H

Computer models and techniques for calculating railcar vibrations are discussed along with criteria for vehicle ride optimization. The effect on vibration of car body structural dynamics, suspension system parameters, vehicle geometry, and wheel and rail excitation are presented. Ride quality vibration data collected on the state-of-the-art car and standard light rail vehicle is compared to computer predictions. The results show that computer analysis of the vehicle can be performed for relatively low cost in short periods of time. The analysis permits optimization of the design as it progresses and minimizes the possibility of excessive vibration on production vehicles. Author

**N76-16762*** Federal Railroad Administration Washington, D.C.
**INTERCITY RAIL-PASSENGER CAR RIDE QUALITY TEST PROGRAM**
Richard L. Scharr and Raymond P. Owings (ENSCO, Inc.) *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 141-158 (For availability see N76-16754 07-53)
CSCL 05H

The Federal Railroad Administration's research and development program relating to intercity rail-passenger ride quality focuses on developing ride quality design criteria and specifications. The FRA ride quality test program and some of the techniques being used to analyze and evaluate the design criteria of the program are discussed. Author

**N76-16763*** Princeton Univ., N.J.
**THE PITCH-HEAVE DYNAMICS OF TRANSPORTATION VEHICLES**
L. M. Sweet and H. H. Richardson (MIT, Cambridge) *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 159-179 refs (For availability see N76-16754 07-53)
CSCL 05H

The analysis and design of suspensions for vehicles of finite length using pitch-heave models is presented. Dynamic models for the finite length vehicle include the spatial distribution of the guideway input disturbance over the vehicle length, as well as both pitch and heave degrees-of-freedom. Analytical results relate the vehicle front and rear accelerations to the pitch and heave natural frequencies, which are functions of vehicle suspension geometry and mass distribution. The effects of vehicle asymmetry and suspension contact area are evaluated. Design guidelines are presented for the modification of vehicle and suspension parameters to meet alternative ride quality criteria. Author

**N76-16764*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**AN APPROACH TO HIGH SPEED SHIP RIDE QUALITY SIMULATION**
W. L. Malone (Naval Sea Systems Command) and J. M. Vickery (Royal Navy) *In its* The 1975 Ride Quality Symp. Nov. 1975 p 181-215 refs (For availability see N76-16754 07-53)
CSCL 05H

The high speeds attained by certain advanced surface ships result in a spectrum of motion which is higher in frequency than that of conventional ships. This fact along with the inclusion of advanced ride control features in the design of these ships resulted in an increased awareness of the need for ride criteria. Such criteria can be developed using data from actual ship operations in varied sea states or from clinical laboratory experiments. A third approach is to simulate ship conditions using measured or calculated ship motion data. Recent simulations have used data derived from a math model of Surface Effect Ship (SES) motion. The model in turn is based on equations of motion which have been refined with data from scale models and SES of up to 101 600-kg (100-ton) displacement. Employment of broad band motion emphasizes the use of the simulators as a design tool to evaluate a given ship configuration in several operational situations and also serves to provide data as to the overall effect of a given motion on crew performance and physiological status. Author

**N76-16765*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EVALUATION OF RIDE QUALITY MEASUREMENT PROCEDURES BY SUBJECTIVE EXPERIMENTS USING SIMULATORS**
Louis T. Klauder, Jr. (Klauder (Louis T.) and Assoc.) and Sherman A. Clevenson *In its* The 1975 Ride Quality Symp. Nov. 1975 p 217-265 refs (For availability see N76-16754 07-53)
CSCL 05H

Since ride quality is, by definition, a matter of passenger response, there is need for a qualification procedure (QP) for establishing the degree to which any particular ride quality measurement procedure (RQMP) does correlate with passenger responses. Once established, such a QP will provide very useful guidance for optimal adjustment of the various parameters which any given RQMP contains. A QP is proposed based on use of a ride motion simulator and on test subject responses to recordings of actual vehicle motions. Test subject responses are used to determine simulator gain settings for the individual recordings such as to make all of the simulated rides equally uncomfortable to the test subjects. Simulator platform accelerations vs. time are recorded with each ride at its equal discomfort gain setting. The equal discomfort platform acceleration recordings are then digitzed. Author

**N76-16766*** University Coll. of Swansea (Wales). Dept. of Mechanical Engineering.
**TECHNIQUES FOR OBTAINING SUBJECTIVE RESPONSE**

**TO VERTICAL VIBRATION**

Michael J. Clarke and David J. Oborne *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 267-286 refs (For availability see N76-16754 07-53)

CSCL 05H

Laboratory experiments were performed to validate the techniques used for obtaining ratings in the field surveys carried out by the University College of Swansea. In addition, attempts were made to evaluate the basic form of the human response to vibration. Some of the results obtained by different methods are described. Author

**N76-16767*** Hampton Inst., Va.

**DEMOGRAPHIC AND PSYCHOLOGICAL VARIABLES AFFECTING TEST SUBJECT EVALUATIONS OF RIDE QUALITY**

Nancy C. Duncan and Harold W. Conley *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 287-321 refs (For availability see N76-16754 07-53)

CSCL 05H

Ride-quality experiments similar in objectives, design, and procedure were conducted, one using the U.S. Air Force Total In-Flight Simulator and the other using the Langley Passenger Ride Quality Apparatus to provide the motion environments. Large samples (80 or more per experiment) of test subjects were recruited from the Tidewater Virginia area and asked to rate the comfort (on a 7-point scale) of random aircraft motion typical of that encountered during STOL flights. Test subject characteristics of age, sex, and previous flying history (number of previous airplane flights) were studied in a two by three by three factorial design. Correlations were computed between one dependent measure, the subject's mean comfort rating, and various demographic characteristics, attitudinal variables, and the scores on Spielberger's State-Trait Anxiety Inventory. An effect of sex was found in one of the studies. Males made higher (more uncomfortable) ratings of the ride than females. Age and number of previous flights were not significantly related to comfort ratings. No significant interactions between the variables of age, sex, or previous number of flights were observed. Author

**N76-16768*** Birmingham Univ. (England). Dept. of Mechanical Engineering.

**HUMAN COMFORT IN RELATION TO SINUSOIDAL VIBRATION**

B. Jones and B. K. N. Rao *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 323-351 refs (For availability see N76-16754 07-53)

CSCL 05H

An investigation was made to assess the overall subjective comfort levels to sinusoidal excitations over the range 1 to 19 Hz using a two axis electrohydrauli vibration simulator. Exposure durations of 16 minutes, 25 minutes, 1 hour, and 2.5 hours have been considered. Subjects were not exposed over such durations, but were instructed to estimate the overall comfort levels preferred had they been constantly subjected to vibration over such durations. Author

**N76-16769*** Old Dominion Univ., Norfolk, Va.

**EFFECT OF VIBRATION IN COMBINED AXES ON SUBJECTIVE EVALUATION OF RIDE QUALITY**

Raymond H. Kirby, Glynn D. Coates (NASA, Langley Res. Center, Langley Station, Va.), Peter J. Mikulka, Thomas K. Dempsey, and Jack D. Leatherwood *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 355-371 refs (For availability see N76-16754 07-53)

CSCL 05H

The effects of simultaneous sinusoidal vibration in the vertical and lateral axes on ratings of discomfort were investigated. The first experiment concentrated on the effects of variation of frequency in the two axes, and the second study concentrated on the effects of amplitude variation in the two axes. Author

**N76-16770*** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

**PASSENGER RIDE QUALITY RESPONSE TO AN AIRBORNE SIMULATOR ENVIRONMENT**

T. D. Wolf, T. W. Rezek, and S. W. Gee *In its* The 1975 Ride Quality Symp. Nov. 1975 p 373-385 refs (For availability see N76-16754 07-53)

CSCL 05H

The present study was done aboard a special aircraft able to effect translations through the center of gravity with a minimum of pitch and roll. The aircraft was driven through controlled motions by an on-board analog computer. The input signal was selectively filtered Gaussian noise whose power spectra approximated that of natural turbulence. This input, combined with the maneuvering capabilities of this aircraft, resulted in an extremely realistic simulation of turbulent flight. The test flights also included varying bank angles during turns. Subjects were chosen from among NASA Flight Research Center personnel. They were all volunteers, were given physical examinations, and were queried about their attitudes toward flying before final selection. In profile, they were representative of the general flying public. Data from this study include (1) a basis for comparison with previous commercial flights, that is, motion dominated by vertical acceleration, (2) extension to motion dominated by lateral acceleration, and (3) evaluation of various bank angles. Author

**N76-16771*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**RIDE QUALITY OF TERMINAL-AREA FLIGHT MANEUVERS**

W. Elliott Schoonover, Jr. *In its* The 1975 Ride Quality Symp. Nov. 1975 p 387-408 refs (For availability see N76-16754 07-53)

CSCL 05H

Complex terminal-area flight maneuvers being considered for airline operations may not be acceptable to passengers. To provide technology in this area, a series of flight experiments was conducted by NASA using the U. S. Air Force Total In-Flight Simulator (TIFS) aircraft to obtain subjective responses of a significant number of passenger test subjects to closely controlled and repeatable flight maneuvers. Regression analysis of the data produced a mathematical model which closely predicts mean passenger ride-comfort rating as a function of the rms six-degree-of-freedom aircraft motions during the maneuver. This ride-comfort model was exercised to examine various synthesized flight maneuvers. Author

**N76-16772*** Virginia Univ., Charlottesville.

**PASSENGER RIDE QUALITY DETERMINED FROM COMMERCIAL AIRLINE FLIGHTS**

L. G. Richards, A. R. Kuhlthau, and I. D. Jacobson *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 409-436 refs (For availability see N76-16754 07-53)

CSCL 05H

The University of Virginia ride-quality research program is reviewed. Data from two flight programs, involving seven types of aircraft, are considered in detail. An apparatus for measuring physical variations in the flight environment and recording the subjective reactions of test subjects is described. Models are presented for predicting the comfort response of test subjects from the physical data, and predicting the overall comfort reaction of test subjects from their moment by moment responses. The correspondence of mean passenger comfort judgments and test subject response is shown. Finally, the models of comfort response based on data from the 5-point and 7-point comfort scales are shown to correspond. Author

**N76-16773*** University Coll. of Swansea (Wales).

**REACTION OF PASSENGERS TO PUBLIC SERVICE VEHICLE RIDE**

Michael J. Clarke and David J. Oborne *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 437-470 refs (For availability see N76-16754 07-53)

CSCL 05H

A series of questionnaire studies is described, which was carried out on passengers in public service vehicles in the United Kingdom particularly cross-channel hovercraft, helicopter and train. The effectiveness of the different rating techniques employed is examined and it is demonstrated that useful and reliable information can be obtained on the effects of such physical parameters as vibration, vehicle motion and noise using rating methods which involve no external standards. Some results obtained from analysis of the survey returns are presented. Author

**N76-16774*** Southampton Univ. (England). Institute of Sound and Vibration Research.

**A REVIEW OF RIDE COMFORT STUDIES IN THE UNITED KINGDOM**

Michael J. Griffin *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 471-499 refs (For availability see N76-16754 07-53)

CSCL 05H

United Kingdom research which is relevant to the assessment of vehicle ride comfort was reviewed. The findings reported in approximately 80 research papers are outlined, and an index to the areas of application of these studies is provided. The data obtained by different research groups are compared, and it is concluded that, while there are some areas of general agreement, the findings obtained from previous United Kingdom research are insufficient to define a general purpose ride comfort evaluation procedure. The degree to which United Kingdom research supports the vibration evaluation procedure defined in the current International Standard on the evaluation of human exposure to whole-body vibration is discussed. Author

**N76-16775*** Royal Aircraft Establishment, Farnborough (England). Human Engineering Div.

**RIDE QUALITY AND INTERNATIONAL STANDARD ISO 2631 (GUIDE FOR THE EVALUATION OF HUMAN EXPOSURE TO WHOLE-BODY VIBRATION)**

Geoff R. Allen *In* NASA. Langley Res. Center The 1975 Ripe Quality Symp. Nov. 1975 p 501-530 refs (For availability see N76-16754 07-53)

CSCL 05H

The evolution of the standard, which is aimed at promoting research and production of more data, and providing some design guidance, is outlined and its contents summarized. Some of the assumptions and information on which it is based are analyzed. Its application to vehicle ride quality is considered in the context of the safety, efficiency and comfort of crew and passengers. The importance of establishing the precise criteria against which vibration limits are required is underlined, particularly the difficulties of first defining comfort and then postulating appropriate levels. Some current and future work related to improving the standard is outlined and additional suggestions offered. Author

**N76-16776*** Janeway Engineering Co., Detroit, Mich.

**ANALYSIS OF PROPOSED CRITERIA FOR HUMAN RESPONSE TO VIBRATION**

R. N. Janeway *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 531-563 refs (For availability see N76-16754 07-53)

CSCL 05H

The development of criteria for human vibration response is reviewed, including the evolution of the ISO standard 2631. The document is analyzed to show why its application to vehicle ride evaluation is strongly opposed. Alternative vertical horizontal limits for comfort are recommended in the ground vehicle ride frequency range above 1 Hz. These values are derived by correlating the absorbed power findings of Pradko and Lee with other established criteria. Special emphasis is placed on working limits in the frequency range of 1 to 10 Hz since this is the most significant area in ground vehicle ride evaluation. Author

**N76-16777*** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamics and Bionics Div.

**THE ISO STANDARD: GUIDE FOR THE EVALUATION OF HUMAN EXPOSURE TO WHOLE-BODY VIBRATION**

H. E. VonGierke *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 565-580 refs (For availability see N76-16754 07-53)

CSCL 05H

The international guideline is discussed in terms of safety and human tolerance. Charts for equal subjective vibration intensity, subjective judgement of equal fatigue, and severe discomfort boundaries are included. F.O.S.

**N76-16778*** Texas Univ., Austin.

**AUTOMOBILE RIDE QUALITY EXPERIMENTS CORRELATED TO ISO-WEIGHTED CRITERIA**

A. J. Healey, R. K. Young, and C. C. Smith *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 581-600 refs (For availability see N76-16754 07-53)

CSCL 05H

As part of an overall study to evaluate the usefulness of ride quality criteria for the design of improved ground transportation systems an experiment was conducted involving subjective and objective measurement of ride vibrations found in an automobile riding over roadways of various roughness. Correlation of the results led to some very significant relationships between passenger rating and ride accelerations. The latter were collapsed using a frequency-weighted root mean square measure of the random vibration. The results suggest the form of a design criterion giving the relationship between ride vibration and acceptable automobile ride quality. Further the ride criterion is expressed in terms that relate to rides with which most people are familiar. The design of the experiment, the ride vibration data acquisition, the concept of frequency weighting and the correlations found between subjective and objective measurements are presented. Author

**N76-16779*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**VIBRATION SIMULATOR STUDIES FOR THE DEVELOPMENT OF PASSENGER RIDE COMFORT CRITERIA**

Thomas K. Dempsey and Jack D. Leatherwood *In its* The 1975 Ride quality Symp. Nov. 1975 p 601-614 refs (For availability see N76-16754 07-53)

CSCL 05H

A test program to determine the total discomfort associated with vehicle vibration is described. The program utilizes a three-degree-of-freedom vibration simulator to determine the effects of multifrequency and multiaxis vibration inputs. The approach to multifrequency vibration includes a separate consideration of the discomfort associated with each frequency component or band of the total spectrum and a subsequent empirical weighting of the discomfort components of these frequency bands when in various random combinations. The results are in the form of equal discomfort curves that specify the discomfort associated with discrete frequencies between 1 and 30 Hz and different acceleration levels. These results provide detailed information of the human discomfort response to increases in acceleration level for each frequency investigated. More importantly, the results provide a method for adding the discomfort associated with separate frequencies to give a total typification of the discomfort of a random spectrum of vibration. Author

**N76-16780*** Virginia Univ., Charlottesville.

**SIMULATOR STUDIES AND PSYCHOPHYSICAL RIDE COMFORT MODELS**

Ralph W. Stone, Jr. *In* NASA. Langley Res. Center The 1975 Ride Quality Symp. Nov. 1975 p 615-644 refs (For availability see N76-16754 07-53)

CSCL 05H

An elementary psychophysical model to predict ride comfort was developed using flight and simulator data where subjects were exposed to six degrees of freedom. The model presumes that the comfort response is proportional to the logarithm of the stimulus above some threshold stimulus. In order to verify this concept of comfort modeling, it was necessary to obtain ride comfort data for single degree of freedom random motions and for combinations of random motions. Accordingly, a simulator program was performed at the NASA Langley Research Center to measure subjective comfort response ratings using one degree of freedom, two degrees of freedom, three degrees of freedom, and six degrees of freedom. An analysis of the single degree of freedom and two degrees of freedom data is presented. Preliminary models of ride comfort response for singl3 degree of freedom random motions and for certain combinations of two degrees of freedom random motions were developed. Author

**N76-16781*#** Scientific Translation Service, Santa Barbara, Calif.

**ATTEMPT TO UNDERSTAND ABSTRACTION**

O. Kuelpe Washington NASA Dec. 1975 14 p Transl. into ENGLISH from Ber. ueber den Kong. fuer Experimentelle Psychol. (West Ger.), v. 18, no. 21, 1904 p 56-68

(Contract NASw-2791)

(NASA-TT-F-16816) Avail: NTIS HC $3.50 CSCL 05E

A description is given of an experiment performed in 1900

to investigate the process of abstraction for optical objects exposed for a short time. The experimental procedure is discussed, and the experiment results are analyzed. Author

**N76-16782*#** North Carolina State Univ., Raleigh.
**INDIVIDUAL DIFFERENCES IN HUMAN ANNOYANCE RESPONSE TO NOISE**
Richard G. Pearson, Franklin D. Hart, and John F. OBrien [1976] 63 p refs
(Grant NGR-34-002-055)
(NASA-CR-144921) Avail: NTIS HC $4.50 CSCL 05E

One hundred sixty-six male and female adult subjects varying in age, occupation, educational level, race, and area of residence were exposed to and rated on the annoyance of six types of aviation and industrial noise stimuli in a simulated living room environment. Mean annoyance ratings to the noise stimuli varied considerably despite the fact that the stimuli levels in the test room were equated at the same peak sound pressure level, 82 db. A considerable, significant range of variation in annoyance ratings was noted across subjects. Factor analysis of the personality-attitude data resulted in identification of several useful factors for multiple regression prediction of annoyance, e.g., noise sensitivity, anti-aviation, noise-health, interference with routine, phobic, imperturbable, and complainer. The results suggest that a generalized sensitivity to noise is a major determinant of the annoyance response. Author

**N76-16783*#** California Univ., La Jolla. Dept. of Neurosciences.
**THE AUDITORY NEURAL NETWORK IN MAN**
Robert Galambos [1975] 23 p refs
(Grants NGR-05-009-198; NS-10482)
(NASA-CR-146357) Avail: NTIS HC $3.50 CSCL 05E

The principles of anatomy and physiology necessary for understanding brain wave recordings made from the scalp are briefly discussed. Brain waves evoked by sounds are then described and certain of their features are related to the physical aspects of the stimulus and the psychological state of the listener. It is proposed that data obtained through probes located outside the head can reveal a large amount of detail about brain activity. It is argued that analysis of such records enables one to detect the response of the nervous system to an acoustic message at the moment of its inception at the ear, and to follow the progress of the acoustic message up through the various brain levels as progressively more complex operations are performed upon it. Even those brain events responsible for the highest level of signal processing - distinguishing between similar signals and making decisions about them - seem to generate characteristic and identifiable electrical waves. Author

**N76-16784*#** California Univ., La Jolla.
**SELECTIVE ATTENTION AND THE AUDITORY VERTEX POTENTIAL. 1: EFFECTS OF STIMULUS DELIVERY RATE**
Vincent L. Schwent, Steven A. Hillyard, and Robert Galambos [1975] 30 p refs
(Grants NGR-05-009-198; MH-25544-01)
(NASA-CR-146390) Avail: NTIS HC $4.00 CSCL 05E

Enhancement of the auditory vertex potentials with selective attention to dichotically presented tone pips was found to be critically sensitive to the range of inter-stimulus intervals in use. Only at the shortest intervals was a clear-cut enhancement of the latency component to stimuli observed for the attended ear. Author

**N76-16785*#** California Univ., La Jolla. Dept. of Neurosciences.
**ELECTROPHYSIOLOGICAL MEASUREMENT OF HUMAN AUDITORY FUNCTION**
Robert Galambos [1975] 27 p refs Sponsored by NASA and NIH
(NASA-CR-146387) Avail: NTIS HC $4.00 CSCL 05E

Contingent negative variations in the presence and amplitudes of brain potentials evoked by sound are considered. Evidence is produced that the evoked brain stem response to auditory stimuli is clearly related to brain events associated with cognitive processing of acoustic signals since their properties depend upon where the listener directs his attention, whether the signal is an expected event or a surprise, and when sound that is listened-for is heard at last. G.G.

**N76-16786*#** California Univ., La Jolla. Dept. of Neurosciences.
**SELECTIVE ATTENTION AND THE AUDITORY VERTEX POTENTIAL. 2: EFFECTS OF SIGNAL INTENSITY AND MASKING NOISE**
Vincent L. Schwent, Steven A. Hillyard, and Robert Galambos [1975] 23 p refs Sponsored in part by NSF
(Grants NGR-05-009-198; MH-25594-01)
(NASA-CR-146389) Avail: NTIS HC $3.50 CSCL 05E

A randomized sequence of tone bursts was delivered to subjects at short inter-stimulus intervals with the tones originating from one of three spatially and frequency specific channels. The subject's task was to count the tones in one of the three channels at a time, ignoring the other two, and press a button after each tenth tone. In different conditions, tones were given at high and low intensities and with or without a background white noise to mask the tones. The N sub 1 component of the auditory vertex potential was found to be larger in response to attended channel tones in relation to unattended tones. This selective enhancement of N sub 1 was minimal for loud tones presented without noise and increased markedly for the lower tone intensity and in noise added conditions. Author

**N76-16787*#** California Univ., La Jolla. Dept. of Neurosciences.
**BRAINSTEM AUDITORY EVOKED RESPONSES IN MAN. 1: EFFECT OF STIMULUS RISE-FALL TIME AND DURATION**
Kurt Hecox, Nancy Squires, and Robert Galambos [1975] 32 p refs
(Grants NGR-05-009-198; NS-10482-01)
(NASA-CR-146391) Avail: NTIS HC $4.00 CSCL 05E

Short latency (under 10 msec) evoked responses elicited by bursts of white noise were recorded from the scalp of human subjects. Response alterations produced by changes in the noise burst duration (on-time) inter-burst interval (off-time), and onset and offset shapes are reported and evaluated. The latency of the most prominent response component, wave V, was markedly delayed with increases in stimulus rise-time but was unaffected by changes in fall-time. The amplitude of wave V was insensitive to changes in signal rise-and-fall times, while increasing signal on-time produced smaller amplitude responses only for sufficiently short off-times. It is concluded that wave V of the human auditory brainstem evoked response is solely an onset response. Author

**N76-16788*#** Columbia Univ., Franklin Square, N.Y.
**SPECIAL ANALYSIS OF COMMUNITY ANNOYANCE WITH AIRCRAFT NOISE REPORTED BY RESIDENTS IN THE VICINITY OF JFK AIRPORT, 1972**
Paul N. Borsky Sep. 1975 85 p refs
(Contract NAS1-13663)
(NASA-CR-132678) Avail: NTIS HC $5.00 CSCL 05E

During the summer of 1972, about 1500 residents were interviewed twice in 11 communities near JFK airport. Detailed aircraft operations reports were also collected for this period, and an effort has been made to analyze recorded human response data in relation to a number of physical exposure parameters. A series of exposure indexes, based on an arithmetic integration of aircraft operations, were correlated with summated aircraft noise annoyance responses. None of these correlations were as good as the CNR index which assumes a logrithmetic integration of numbers of aircraft exposures and includes a day-night differential weighting of 10:1. There were substantial variations in average annoyance responses among communities with similar CNR exposures, substantiating previous findings that attitudinal and other personal variables also play an important role in determining annoyance differences. Author

**N76-16789#** National Physical Lab., Teddington (England). Div. of Computer Science.
**AN AUTOMATED MEDICAL HISTORY-TAKING PROJECT WITH VIDEOTAPE INTERVIEWING OF IMMIGRANT PSYCHIATRIC PATIENTS**
C. R. Evans, N. Masters (Guys Hosp. Med. School), H. B. Milne (Lynfield Mt. Hosp.), and M. Hashim (Lynfield Mt. Hosp.) Apr.

1975 9 p refs
(NPL-Com-79) Avail: NTIS HC $3.50

A project aimed at interviewing patients without human intervention is described. The questionnaire is prerecorded on videotape, and the patient operates buttons on a response box. The replies represented by a choice from 4 tones are recorded on a cassette tape. It is shown that the system can also be effectively used to interview patients in languages other than English. Results are discussed for Asian male patients. ESA

**N76-16790#** Army Personnel Research Committee, London (England).
**THE EFFECT OF A FILTERED CONTROL ON OPERATOR'S HAND TREMOR**
M. Waygood 1974 16 p refs
(AD-A014105; APRC-72/CS7; DRIC-BR47799) Avail: NTIS CSCL 05/5

Twelve operators compensated for errors they produced while holding a spot central in a stationary square target. Filtering their control movements obtained from strain gauges increased their proficiency compared with a condition in which the control movements were presented at a gain of 189. It is argued that filtering of the operator's control demands may improve his performance, when the target is stationary. GRA

**N76-16791#** Texas Christian Univ., Fort Worth. Inst. for the Study of Cognitive Systems.
**LEARNING STRATEGY TRAINING PROGRAM: QUESTIONS AND ANSWERS FOR EFFECTIVE LEARNING Final Report, Jan. 1974 - May 1975**
Donald F. Dansereau, Gary L. Long, Barbara A. McDonald, Tomme R. Actkinson, Karen W. Collins, Selby H. Evans, Alice M. Ellis, and Stephen Williams Jun. 1975 202 p refs
(Contract F41609-74-C-0013; AF Proj. 1121)
(AD-A014725; AFHRL-TR-75-48) Avail: NTIS CSCL 05/10

The report presents an effective integrated learning strategy program emphasizing a connection technique employing questions and answers. The components were derived from a review of the educational and psychological literature and from an analysis of the responses to the learning strategy inventory, which were conducted during this same research effort. Also, two other training packages (visual imagery and paraphrasing connection) were evaluated along with this package in a controlled experiment. This program improved long term retention of factual material. With appropriate insertions of blank pages this report can be used to provide learning strategy training. GRA

**N76-16792#** Texas Christian Univ., Fort Worth. Inst. for the Study of Cognitive Systems.
**LEARNING STRATEGY TRAINING PROGRAM: VISUAL IMAGERY FOR EFFECTIVE LEARNING Final Report, Jan. 1974 - May 1975**
Donald F. Dansereau, Gary L. Long, Barbara A. McDonald, Tomme R. Actkinson, Karen W. Collins, Selby H. Evans, Alice M. Ellis, and Stephen Williams Jun. 1975 200 p refs
(Contract F41609-74-C-0013; AF Proj. 1121)
(AD-A014724; AFRHL-TR-75-47) Avail: NTIS CSCL 05/10

The report presents an effective integrated learning strategy program emphasizing a connection technique using visual imagery. The components were derived from a review of the educational and psychological literature and from an analysis of the responses to the learning strategy inventory, which were conducted during this same research effort. Also, two other training packages (paraphrasing and question-answer connection) were evaluated along with this package in a controlled experiment. This program improved long term retention of factual material and appeared to help lower reading ability students more than higher reading ability students. With appropriate insertions of blank pages this report can be used to provide learning strategy training. GRA

**N76-16793#** Texas Christian Univ., Fort Worth. Inst. for the Study of Cognitive Systems.
**LEARNING STRATEGY TRAINING PROGRAM: PARAPHRASING STRATEGY FOR EFFECTIVE LEARNING Final Report, Jan. 1974 - May 1975**
Donald F. Dansereau, Gary L. Long, Barbara A. McDonald, Tomme R. Actkinson, Karen W. Collins, Selby H. Evans, Alice M. Ellis, and Stephen Williams Jun. 1975 201 p refs
(Contract F41609-74-C-0013; AF Proj. 1121)
(AD-A014723; AFHRL-TR-75-46) Avail: NTIS CSCL 05/10

The report presents an effective integrated learning strategy program emphasizing a connection technique using paraphrasing. The components were derived from a review of the educational and psychological literature and from an analysis of the responses to the learning strategy inventory, which were conducted during this same research effort. Also, two other training packages (visual imagery and question-answer connection) were evaluated along with this package in a controlled experiment. The results of this experiment showed improved long term retention, when using paraphrasing for the trained group, of 55% over an untrained control group. With appropriate insertion of blank pages this report can be used to provide learning strategy training. GRA

**N76-16794#** Texas Christian Univ., Fort Worth. Inst. for the Study of Cognitive Systems.
**EFFECTIVE LEARING STRATEGY TRAINING PROGRAM: DEVELOPMENT AND ASSESSMENT Final Report, Jan. 1974 - May 1975**
Donald F. Dansereau, Gary L. Long, Barbara A. McDonald, Tomme R. Actkinson, Alice M. Ellis, Karen W. Collins, Stephen Williams, and Selby H. Evans Brooks AFB, Tex. AFHRL Jun. 1975 81 p refs
(Contract F41609-74-C-0013; AF Proj. 1121)
(AD-A014722; AFHRL-TR-75-41) Avail: NTIS CSCL 05/10

Potentially effective and trainable learning strategies were identified by an analysis of a specially developed learning strategy inventory and a review of educational and psychological review literature. Four aspects of the learning process suggested the usefulness of special training. These were the identification of important or unfamiliar material, the applications of techniques for the comprehension and retention of this information, the efficient retrieval of information and the skill in coping with distractions during the foregoing processes. A training program was developed for teaching selected specific strategies, including the three alternative comprehension/retention strategies of paraphrasing, question-answering, and the use of visual imagery, in such a way as to compare the three alternative connection techniques. The results indicated that minimal strategy training showed significant results in long term retention, although no reliable differences were found in immediate testing. Further refining of the techniques was recommended. An effective strategy training program suitable for implementation in technical training was created, modified, and assessed. GRA

**N76-16795#** Texas Christian Univ., Fort Worth. Inst. for the Study of Cognitive Systems.
**LEARNING STRATEGY INVENTORY DEVELOPMENT AND ASSESSMENT Final Report, Jan. 1974 - May 1975**
Donald F. Dansereau, Gary L. Long, Barbara A. McDonald, Tomme R. Actkinson, Karen W. Collins, Selby H. Evans, Alice M. Ellis, and Stephen Williams Jun. 1975 111 p refs
(Contract F41609-74-C-0013; AF Proj. 1121)
(AD-A014721; AFHRL-TR-75-40) Avail: NTIS CSCL 05/10

A learning strategy inventory composed of 201 multiple-choice items, based upon similar work and aspects suggested from a literature review, was developed. Correlational and factor analyses (based on approximately 200 students) were performed to provide a basis for identifying trainable learning strategies. Four phases of the learning process were identified and incorporated into a learning strategy training program (reported elsewhere). The learning inventory provides a significant first step in the development of a more general instrument for diagnosing learning strategy inadequacies in specific individuals. GRA

**N76-16796#** Air Force Human Resources Lab., Brooks AFB, Tex.
**DIMENSIONS OF JOB SATISFACTION, INITIAL DEVELOPMENT OF THE AIR FORCE OCCUPATIONAL ATTITUDE INVENTORY Interim Report, 1 Jul. 1972 - 30 Jun. 1974**
Thomas C. Tuttle, R. Bruce Gould, and Joe T. Hazel Jun. 1975 37 p refs
(AF Proj. 7734)
(AD-A014796; AFHRL-TR-75-1) Avail: NTIS CSCL 05/9

The report describes the initial development of the Air Force Occupational Attitude Inventory. From a selective review of

studies that ascribed to a multi-faceted approach, several categories or content areas were identified. An extensive item pool was prepared and reviewed by judges to provide information regarding item-category agreement, item ambiguity, and item redundancy. The revised version of the inventory consisted of 348 items distributed across 35 facets. An 8-point bi-polar rating scale without a neutral point was developed for rating the items. Details regarding the final version of the inventory booklet, suitable for administration to airmen, are provided. The entire listing of 348 items and descriptions of the 35 categories are included in the report for possible use of other researchers. Subsequent actions and future uses of the Occupational Attitude Inventory are discussed. GRA

**N76-16797#** Battelle Human Affairs Research Centers, Seattle, Wash.
**DEFINING RESEARCH NEEDS TO INSURE CONTINUED JOB MOTIVATION OF AIR TRAFFIC CONTROLLERS IN FUTURE AIR TRAFFIC CONTROL SYSTEMS Final Report**
Stanley M. Nealey, George C. Thornton, III (Colo. State Univ.), William S. Maynard, Michael K. Lindell, Richard Hodapp (Colo. State Univ.), L. T. Love, L. B. Myers, R. E. Abrams, and J. A. Hebert Apr. 1975 130 p refs
(Contract DOT-FA74WAI-499)
(AD-A014719) Avail: NTIS CSCL 05/10

The study was made necessary by FAA plans to progressively introduce automated equipment into the ATC system over the next ten years. Such equipment is expected to bring about striking changes in the actual work activities of ATCs in controlling aircraft. Experience with the introduction of NAS Stage A and ARTS III equipment has focused concern on th3 motivational reaction of ATCs to automated equipment. The objective of this study was to forecast the types of motivational problems likely to be experienced in the face of increasing automation and to suggest social science research necessary to the definition and amelioration of these problems. GRA

**N76-16798#** Human Engineering Labs., Aberdeen Proving Ground, Md.
**PILOT PERFORMANCE IN A HELICOPTER SIMULATOR Final Technical Memorandum**
John P. Waugh Sep. 1975 336 p refs
(AD-A017441; HEL-TM-23-75) Avail: NTIS CSCL 14/2

Six Army helicopter pilots, instrument rated, flew a difficult precision instrument flight pattern in this Laboratory's GAT-2H helicopter simulator. For each flight, each subject was given a different combination of thrust to weight, cyclic control sensitivity and cyclic spring centering force gradient condition making up an incomplete, balanced block-type experimental design. Several error measurements were recorded during the trials; however, none could be satisfactorily utilized either to predict accuracy of performance or to be an indicator of relative workload. An unanticipated large variation of measures taken is thought to be the cause. Additional approaches and further study of the problem is recommended. GRA

**N76-16799#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PSYCHOLOGY AND PSYCHOPATHOLOGY OF SOLITUDE**
O. N. Kuznetsov and V. I. Lebedev 30 Jan. 1975 408 p refs Transl. into ENGLISH of the book "Psikhologiya i Psikhopatologiya Odinochestva" Moscow, Izd. Meditsina, 1972 393 p
(AD-A007454; FTD-MT-24-1509-74) Avail: NTIS CSCL 05/10

Research on the physiological and psychic changes in animals and man under various conditions of isolation is summarized. Experimental data and literature materials are used to illuminate the problem of solitude in its psychological, psychiatric, philosophical, and sociological aspects. Measures for the prevention of neuropsychic illnesses are presented. Author (GRA)

**N76-16800#** Navy Personnel Research and Development Center, San Diego, Calif.
**THE EFFECTS OF PRACTICE AND POSITIONAL VARIABLES IN THE ACQUISITION OF A PHYSICALLY COMPLEX PSYCHOMOTOR SKILL Interim Report, Jul. 1974 - Jan. 1975**
Macy L. Abrams, Harvey B. Schow, and Jon K. Grice Jul. 1975 30 p refs
(AD-A015282; NPRDC-TR-76-7) Avail: NTIS CSCL 05/10

The investigation (1) evaluates distributed/massed practice schedules for learning a physically complex psychomotor skill within the constraints of a real-world learning environment and (2) determines if there are interaction effects between practice and the positional variables in the acquisition of the skill. Distributed/massed practice was studied from two aspects: trial length and session length. GRA

**N76-16733** Joint Publications Research Service, Arlington, Va.
**CORRELATION BETWEEN THE AUTOMONIC COMPONENTS OF THE ORIENTATION REACTION AND THE NATURE OF THE INFORMATION RECEIVED BY AN AIRMAN**
R. I. Brusnichkina *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 78-85 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 49-54 (For availability see N76-16730 07-51)

**N76-16734** Joint Publications Research Service, Arlington, Va.
**COLOR PERCEPTION AFTER INTENSIVE PHOTOSTIMULATION**
V. I. Shostak *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 92-97 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 57-60 (For availability see N76-16730 07-51)

**N76-16736** Joint Publications Research Service, Arlington, Va.
**SENSORY AND MOTOR COMPONENTS OF EYE FIXATION MOVEMENT DURING EXPOSURE TO ANGULAR ACCELERATIONS**
V. I. Babiyak *In its* Space Biol. and Aerospace Med., Vol. 9, No. 5, 1975 (JPRS-66404) 17 Dec. 1975 p 106-113 refs Transl. into ENGLISH from Kosm. Biol. Aviakosm. Med. (Moscow), v. 9, no. 5, Sep.-Oct. 1975 p 66-70 (For availability see N76-16730 07-51)

## 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

**N76-16801*#** AiResearch Mfg. Co., Torrance, Calif.
**PORTABLE OXYGEN SUBSYSTEM (POS) Final Report**
Dec. 1975 94 p
(Contract NAS9-14457)
(NASA-CR-147401; Rept-75-12328) Avail: NTIS HC $5.00 CSCL 06K

Concept selection, design, fabrication, and testing of a Portable Subsystem (POS) for use in space shuttle operations are described. Tradeoff analyses were conducted to determine the POS concept for fabrication and testing. The fabricated POS was subjected to unmanned and manned tests to verify compliance with statement of work requirements. The POS used in the development program described herein met requirements for the three operational modes -- prebreathing, contaminated cabin, and personnel rescue system operations. Author

**N76-16802*#** Hamilton Standard, Windsor Locks, Conn.
**PORTABLE OXYGEN SUBSYSTEM Final Report**
Dec. 1975 241 p refs
(Contract NAS9-14458)
(NASA-CR-147428; SP05T75) Avail: NTIS HC $8.00 CSCL 06K

The concept and design of a portable oxygen device for use in the space shuttle orbiter is presented. Hardware fabrication and acceptance tests (i.e., breadboard models) are outlined and discussed. Optimization of the system (for weight, volume, safety, costs) is discussed. The device is of the rebreather type, and provides a revitalized breathing gas supply to a crewman for

denitrogenization and emergency activities. Engineering drawings and photographs of the device are shown. Author

**N76-16803*#** Hamilton Standard, Windsor Locks, Conn.
**DESIGN, DEVELOPMENT, AND FABRICATION OF A PROTOTYPE ICE PACK HEAT SINK SUBSYSTEM. FLIGHT EXPERIMENT PHYSICAL PHENOMENA EXPERIMENT CHEST Final Report**
George J. Roebelen, Jr. and W. Clark Dean, II Dec. 1975 100 p refs
(Contract NAS2-8665)
(NASA-CR-137768; SVHSER6784) Avail: NTIS HC$5.00 CSCL 06K

The concept of a flight experiment physical phenomena experiment chest, to be used eventually for investigating and demonstrating ice pack heat sink subsystem physical phenomena during a zero gravity flight experiment, is described. Author

**N76-16804*#** Joint Publications Research Service, Arlington, Va.
**CONSTRUCTING THE MOTIONS OF MANIPULATING SYSTEMS**
A. A. Kobrinskiy and A. Ye. Kobrinskiy Washington NASA Jan. 1976 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk USSR (Moscow), v. 224, no. 5, 11 Oct. 1975 p 1030-1033
(NASA Order W-13183)
(NASA-TT-F-16859) Avail: NTIS HC $3.50 CSCL 05H

Algorithms for the control of mechanical hands are reported. Author

**N76-16805#** Aeronautical Research Inst. of Sweden, Stockholm.
**A METHOD FOR THE MEASUREMENT OF ENERGY ABSORPTION IN THE HUMAN HAND USING VARIOUS TYPES OF HAND TOOLS**
Ingmar Johnson 1975 21 p refs
(FFA-Memo 97) Avail: NTIS HC $3.50

To correlate the ailment commonly known as vibration induced white fingers, observed among manual workers, to the energy absorbed in the hand, a method for the measurement of vibrational energy dissipated in the human hand using certain types of hand tools such as pneumatic roll drills was developed, based on measurements of vibrational force and acceleration as close as possible to the hand palm surface. A special handle equipped with force transducers and accelerometers corresponding to each one of three orthogonal directions in space, was used. The effective portion of the handle has low weight to make the influence of the handle mass negligible compared with the mass of the hand. By integration of the acceleration signal, the corresponding instantaneous velocity is obtained. Analog multiplication of the force and velocity vectors produce a single output proportional to the energy dissipated per unit time or the dissipated power. The method is generally applicable to complex vibrations including random vibrations. Dissipated energy may be obtained quantitatively by calibrating the instrumentation using sinusoidal vibrations with known amplitude and frequency. Author (ESA)

# 55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

# 59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

# 60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

**N76-16806** Iowa State Univ. of Science and Technology, Ames.
**A MICROPROCESSOR-BASED INPUT/OUTPUT SYSTEM FOR AN INTERACTIVE COMPUTER Ph.D. Thesis**
Wayne Elmer Jones 1975 80 p
Avail: Univ. Microfilms Order No. 76-1849

The design of a microprocessor-based input/output system (I/O) was investigated. The primary objective was to develop support for a variety of terminal types using a microprocessor-based I/O system under firmware control. The system utilizes a distributed architecture. Each special purpose processor consists of a microprocessor surrounded by supporting hardware. A read-only memory is attached to each microprocessor to provide control information. This implementation combines the high efficiency of the special purpose processor with the inherent flexibility of a software controlled general purpose processor. The investigation demonstrated that currenly available microprocessors are capable of performing the I/O function for a large computer system if the system is being utilized interactively by a number of terminals. Dissert. Abstr.

**N76-16807** Purdue Univ., Lafayette, Ind.
**SECURE INFORMATION FLOW IN COMPUTER SYSTEMS Ph.D. Thesis**
Dorothy Elizabeth Robling Denning 1975 180 p
Avail: Univ. Microfilms Order No. 76-514

Mechanisms were investigated which guarantee the secure flow of information between a set of security classes in a computing system. These mechanisms were examined within the framework of a mathematical model suitable for concisely formulating the requirements of secure information flow. The model provides a unifying view of all systems that restrict information flow and enables a classification of them according to security objectives. The central component of the model is a lattice structure derived from the security classes and justified by the semantics of information flow. The lattice properties were used to develop two mechanisms that verify the secure execution of a program addressing storage locations associated with different security classes. The first operates in an environment in which the security class associated with each location is invariant. The second operates in a more complex environment in which the security class associated with each location is to be determined by the information contained in it. Dissert. Abstr.

**N76-16808** Northwestern Univ., Evanston, Ill.
**MODELS FOR GRAPHICALLY-ENHANCED DATA BASE MANAGEMENT SYSTEM DESIGN Ph.D. Thesis**
Wayne Dennis Dominick 1975 224 p
Avail: Univ. Microfilms Order No. 75-29614

The overall objective of this research is to formulate comprehensive and generalized methodologies for the design of a graphically-enhanced data base management system which is both maximally data independent and terminal device independnet, and thereby develop the theory and the models which have general applicability to data independent, structurally extensible and application extensible data base management system design and to device independent graphics system design, as well as

to their combined and integrated usage. The research methodology consists of the development of four basic design models: the logical data, the user language, the physical storage, and the display. Each of the design models is contrasted with existing techniques and, in each case, is shown to be a significant extension of the current state of the art. Dissert. Abstr.

**N76-16809** Northwestern Univ., Evanston, Ill.
**THE INFORMATION FLOW STRUCTURE WITHIN A DISTRIBUTED-INTELLIGENCE COMPUTER SYSTEM Ph.D. Thesis**
Kenneth John King 1975 102 p
Avail: Univ. Microfilms Order No. 75-29698

A distributed-intelligence computer architecture is presented in which control of the data addressing is separated from control of the data manipulation. A unified stream approach is used to describe all information flow within the system. The resulting architecture exhibits good performance on data processing problems based on a comparison with conventional (IBM System/360) and streaming architectures while having a much lower information flow within the system. This is obtained by eliminating most of the address flow found in conventional computer architectures. The distribution of intelligence provides a closer bandwidth match between computer subsystems. The lower information flow requirements will allow a communications protocol to be developed which can provide the flexibility and modularity of a computer network at the computer system level. Dissert. Abstr.

**N76-16810*#** Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.
**INPUTB: A THERMAL/STRUCTURAL DATA INTERFACE PROGRAM FOR 2-DIMENSIONAL AND 3-DIMENSIONAL INTERPOLATION**
R. G. Vos and J. W. Straayer 1 Sep. 1975 58 p refs (Contract NAS8-30615)
(NASA-CR-144119; D180-19024-1) Avail: NTIS HC $4.50 CSCL 09B

A computer program (INPUTB) for interpolation in both space and time, and based on a linear interpolation scheme using simplex spatial regions is described. The program was developed to provide data interfacing between the output from thermal analyzers and the input to the BOPACE 3-D program. The INPUTB interpolator is of a general nature and could be used for other tasks. The INPUTB program utilizes temperature values which are given at some sequence of time for a list of strategically located thermal nodes. It operates on these values by performing a double interpolation to provide temperature values at another desired sequence of times for a list of structural nodes. Author

**N76-16811*#** Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.
**BOPACE 3-D ADDENDUM: THE BOEING PLASTIC ANALYSIS CAPABILITIES FOR 3-DIMENSIONAL SOLIDS USING ISOPARAMETRIC FINITE ELEMENTS**
R. G. Vos and J. W. Straayer 1 Sep. 1975 14 p ref (Contract NAS8-30615)
(NASA-CR-144120; D180-18677-2) Avail: NTIS HC $3.50 CSCL 09B

Modifications and additions incorporated into the BOPACE 3-D program are described. Updates to the program input data formats, error messages, file usage, size limitations, and overlay schematic are included. Author

**N76-16812*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
**APPLICATIONS OF COMPUTER GRAPHICS IN ENGINEERING**
1975 661 p refs Conf. Held at Hampton, Va., 1-2 Oct. 1975
(NASA-SP-390) Avail: NTIS HC $16.25 CSCL 09B

Various applications of interactive computer graphics to the following areas of science and engineering were described: design and analysis of structures, configuration geometry, animation, flutter analysis, design and manufacturing, aircraft design and integration, wind tunnel data analysis, architecture and construction, flight simulation, hydrodynamics, curve and surface fitting, gas turbine engine design, analysis, and manufacturing, packaging of printed circuit boards, spacecraft design. For individual titles, see N76-16813 through N76-16846.

**N76-16813*** Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
**THE DEVELOPMENT OF AN ENGINEERING COMPUTER GRAPHICS LABORATORY**
David C. Anderson and Richard E. Garrett *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 1-14 refs (For availability see N76-16812 07-60)
CSCL 09B

Hardware and software systems developed to further research and education in interactive computer graphics were described, as well as several of the ongoing application-oriented projects, educational graphics programs, and graduate research projects. The software system consists of a FORTRAN 4 subroutine package, in conjunction with a PDP 11/40 minicomputer as the primary computation processor and the Imlac PDS-1 as an intelligent display processor. The package comprises a comprehensive set of graphics routines for dynamic, structured two-dimensional display manipulation, and numerous routines to handle a variety of input devices at the Imlac. Author

**N76-16814*** Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
**AUTOMATED FINITE ELEMENT GRID BREAK-UP METHOD, A VERIFICATION OF THE SIX NODE AVERAGING APPROACH**
H. J. Barten *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 15-25 refs (For availability see N76-16812 07-60)
CSCL 09B

The verification of the nodal averaging method for generating automated finite triangular element grids was demonstrated. This was accomplished with a six node averaging program (SNAP) which was placed on an IBM 2250 vector graphics scope terminal. The advantage of this method is that it is unnecessary to program time consuming geometric division and transition algorithms. Author

**N76-16815*** Sperry Rand Corp., Huntsville, Ala. Sperry Support Services.
**APPLICATION OF THE CINGEN PROGRAM A THERMAL NETWORK DATA GENERATOR**
William E. Shultz and Ronald P. Schmitz *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 27-47 refs (For availability see N76-16812 07-60)
CSCL 09B

The application of the CINGEN computer program and two of its supporting programs for the evaluation of structural and thermal performance of physical systems was described. The CINGEN program was written and implemented to avoid the duplication effort of performing a finite element approach for structural analysis and a finite differencing technique for thermal analysis, as well as the desire for a geometrical representation of the thermal model to reduce modeling errors. The program simplifies the thermal modeling process by performing all of the capacitance and conductance calculations normally done by the analyst. Each solid element is divided into five tetrahedrons, allowing the total volume to be calculated precisely. A sample problem was illustrated. Author

**N76-16816*** Grumman Aerospace Corp., Bethpage, N.Y.
**QUICK-GEOMETRY, A RAPID RESPONSE METHOD FOR MATHEMATICALLY MODELING CONFIGURATION GEOMETRY**
Alfred F. Vachris, Jr. and Larry S. Yaeger *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 49-73 refs (For availability see N76-16812 07-60)
CSCL 09B

The philosophy, development, and various applications of the QUICK-GEOMETRY system were outlined. This system provides a practical method for developing the geometry models that are essential to the operation of computer-based design and manufacturing systems. Of particular interest are the various methods for modeling surface geometry that are used by aerodynamic analysis codes. Author

**N76-16817*** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Civil Engineering.
**COMPUTER-GENERATED ANIMATION FOR ANALYSIS AND DESIGN**
Larry J. Feeser *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 75-81 refs (For availability see N76-16812 07-60)
CSCL 09B

The development of computer-generated animation techniques was reviewed and some examples of the current state of the art were described. A number of ways in which computer-generated animation can be used were examined in relation to the suitability for the engineering task at hand. The examples described are primarily concerned with attempting to combine two different types of simulation: that of superposition of an engineering design on the surrounding real world, and an evaluation of this simulation both from an engineering design and an aesthetic point of view. Author

**N76-16818*** Control Data Corp., Rockville, Md.
**THE CONTROL DATA 'GIRAFFE' SYSTEM FOR INTERACTIVE GRAPHIC FINITE ELEMENT ANALYSIS**
S. Park and D. M. Brandon, Jr. *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 83-109 (For availability see N76-16812 07-60)
CSCL 09B

The Graphical Interface for Finite Elements (GIRAFFE) general purpose interactive graphics application package was described. This system may be used as a pre/post processor for structural analysis computer programs. It facilitates the operations of creating, editing, or reviewing all the structural input/output data on a graphics terminal in a time-sharing mode of operation. An application program for a simple three-dimensional plate problem was illustrated. Author

**N76-16819*** Sandia Labs., Albuquerque, N.Mex.
**THREE-DIMENSIONAL STRUCTURAL ANALYSIS USING INTERACTIVE GRAPHICS**
Johnny Biffle and Hugh A. Sumlin *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 111-131 refs Sponsored by ERDA (For availability see N76-16812 07-60)
CSCL 09B

The application of computer interactive graphics to three-dimensional structural analysis was described, with emphasis on the following aspects: (1) structural analysis, and (2) generation and checking of input data and examination of the large volume of output data (stresses, displacements, velocities, accelerations). Handling of three-dimensional input processing with a special MESH3D computer program was explained. Similarly, a special code PLTZ may be used to perform all the needed tasks for output processing from a finite element code. Examples were illustrated. Y.J.A.

**N76-16820*** Lockheed-California Co., Burbank.
**GRAPHICS FLUTTER ANALYSIS METHODS, AN INTERACTIVE COMPUTING SYSTEM AT LOCKHEED-CALIFORNIA COMPANY**
Nick A. Radovcich *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 133-165 refs (For availability see N76-16812 07-60)
CSCL 09B

An interactive computer graphics system, Graphics Flutter Analysis Methods (GFAM), was developed to complement FAMAS, a matrix-oriented batch computing system, and other computer programs in performing complex numerical calculations using a fully integrated data management system. GFAM has many of the matrix operation capabilities found in FAMAS, but on a smaller scale, and is utilized when the analysis requires a high degree of interaction between the engineer and computer, and schedule constraints exclude the use of batch entry programs. Applications of GFAM to a variety of preliminary design, development design, and project modification programs suggest that interactive flutter analysis using matrix representations is a feasible and cost effective computing tool. Author

**N76-16821*** McDonnell Aircraft Co., St. Louis, Mo.
**INTERACTIVE COMPUTER AIDED TECHNOLOGY, EVOLUTION IN THE DESIGN/MANUFACTURING PROCESS**
C. H. English *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 167-188 (For availability see N76-16812 07-60)
CSCL 09B

A powerful computer-operated three dimensional graphic system and associated auxiliary computer equipment used in advanced design, production design, and manufacturing was described. This system has made these activities more productive than when using older and more conventional methods to design and build aerospace vehicles. With the use of this graphic system, designers are now able to define parts using a wide variety of geometric entities, define parts as fully surface 3-dimensional models as well as 'wire-frame' models. Once geometrically defined, the designer is able to take section cuts of the surfaced model and automatically determine all of the section properties of the planar cut, lightpen detect all of the surface patches and automatically determine the volume and weight of the part. Further, his designs are defined mathematically at a degree of accuracy never before achievable. Author

**N76-16822*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**APPLICATIONS OF COMPUTER GRAPHICS TO AIRCRAFT SYNTHESIS**
Ralph L. Carmichael and Richard Putnam *In its* Appl. of Computer Graphics in Eng. 1975 p 189-201 refs (For availability see N76-16812 07-60)
CSCL 09B

The history of the development of an aircraft configuration synthesis program using interactive computer graphics was described. A system based on time-sharing was compared to two different concepts based on distributed computing. Author

**N76-16823*** British Aircraft Corp., Preston (England). Military Aircraft Div.
**USE OF GRAPHICS IN THE DESIGN OFFICE AT THE MILITARY AIRCRAFT DIVISION OF THE BRITISH AIRCRAFT CORPORATION**
W. A. Coles *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 203-231 refs (For availability see N76-16812 07-60)
CSCL 09B

The CAD/CAM interactive computer graphics system was described; uses to which it has been put were shown, and current developments of the system were outlined. The system supports batch, time sharing, and fully interactive graphic processing. Engineers using the system may switch between these methods of data processing and problem solving to make the best use of the available resources. It is concluded that the introduction of on-line computing in the form of teletypes, storage tubes, and fully interactive graphics has resulted in large increases in productivity and reduced timescales in the geometric computing, numerical lofting and part programming areas, together with a greater utilization of the system in the technical departments. Author

**N76-16824*** Israel Aircraft Industries Ltd., Lod.
**INTERACTIVE COMPUTER GRAPHICS SYSTEM FOR STRUCTURAL SIZING AND ANALYSIS OF AIRCRAFT STRUCTURES**
Dror Bendavid, Aharon Pipano, Alex Raibstein, and Emil Somekh *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 233-256 refs (For availability see N76-16812 07-60)
CSCL 09B

A computerized system for preliminary sizing and analysis of aircraft wing and fuselage structures was described. The system is based upon repeated application of analytical program modules, which are interactively interfaced and sequence-controlled during the iterative design process with the aid of design-oriented graphics software modules. The entire process is initiated and controlled via low-cost interactive graphics terminals driven by a remote computer in a time-sharing mode. Author

**N76-16825*** Sigma Corp., Los Altos, Calif.
**COMPUTER GRAPHICS APPLICATION IN THE ENGINEERING DESIGN INTEGRATION SYSTEM**
C. R. Glatt, R. W. Abel, G. N. Hirsch, G. E. Alford, W. N. Colquitt,

and W. A. Stewart *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 257-286 refs (For availability see N76-16812 07-60)
(Contract NAS9-12829; NAS9-13584; NAS9-14520)
CSCL 09B

The computer graphics aspect of the Engineering Design Integration (EDIN) system and its application to design problems were discussed. Three basic types of computer graphics may be used with the EDIN system for the evaluation of aerospace vehicles preliminary designs: offline graphics systems using vellum-inking or photographic processes, online graphics systems characterized by direct coupled low cost storage tube terminals with limited interactive capabilities, and a minicomputer based refresh terminal offering highly interactive capabilities. The offline line systems are characterized by high quality (resolution better than 0.254 mm) and slow turnaround (one to four days). The online systems are characterized by low cost, instant visualization of the computer results, slow line speed (300 BAUD), poor hard copy, and the early limitations on vector graphic input capabilities. The recent acquisition of the Adage 330 Graphic Display system has greatly enhanced the potential for interactive computer aided design. Y.J.A.

**N76-16826*** Texas Univ., Austin.
**SOME RESEARCH ADVANCES IN COMPUTER GRAPHICS THAT WILL ENHANCE APPLICATIONS TO ENGINEERING DESIGN**
John J. Allan, III *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 287-295 refs (For availability see N76-16812 07-60)
CSCL 09B

Research in man/machine interactions and graphics hardware/software that will enhance applications to engineering design was described. Research aspects of executive systems, command languages, and networking used in the computer applications laboratory are mentioned. Finally, a few areas where little or no research is being done were identified. Author

**N76-16827*** Lockheed-California Co., Burbank.
**AN INTERACTIVE GRAPHICS PROGRAM TO RETRIEVE, DISPLAY, COMPARE, MANIPULATE, CURVE FIT, DIFFERENCE AND CROSS PLOT WIND TUNNEL DATA**
Robert D. Elliott, Norbert M. Werner, and William M. Baker *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 297-324 (For availability see N76-16812 07-60)
CSCL 09B

The Aerodynamic Data Analysis and Integration System (ADAIS), developed as a highly interactive computer graphics program capable of manipulating large quantities of data such that addressable elements of a data base can be called up for graphic display, compared, curve fit, stored, retrieved, differenced, etc., was described. The general nature of the system is evidenced by the fact that limited usage has already occurred with data bases consisting of thermodynamic, basic loads, and flight dynamics data. Productivity using ADAIS of five times that for conventional manual methods of wind tunnel data analysis is routinely achieved. In wind tunnel data analysis, data from one or more runs of a particular test may be called up and displayed along with data from one or more runs of a different test. Curves may be faired through the data points by any of four methods, including cubic spline and least squares polynomial fit up to seventh order. Author

**N76-16828*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**APPLICATION OF INTERACTIVE COMPUTER GRAPHICS IN WIND-TUNNEL DYNAMIC MODEL TESTING**
Robert V. Doggett, Jr. and Charles E. Hammond (Army Air Mobility R and D Lab.) *In its* Appl. of Computer Graphics in Eng. 1975 p 325-353 refs (For availability see N76-16812 07-60)
CSCL 09B

The computer-controlled data-acquisition system recently installed for use with a transonic dynamics tunnel was described. This includes a discussion of the hardware/software features of the system. A subcritical response damping technique, called the combined randomdec/moving-block method, for use in windtunnel-model flutter testing, that has been implemented on the data-acquisition system, is described in some detail. Some results using the method are presented and the importance of using interactive graphics in applying the technique in near real time during wind-tunnel test operations is discussed. Author

**N76-16829*** Cornell Univ., Ithaca, N.Y.
**COMPUTER GRAPHICS IN ARCHITECTURE AND ENGINEERING**
Donald P. Greenberg *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 355-359 (For availability see N76-16812 07-60)
CSCL 09B

The present status of the application of computer graphics to the building profession or architecture and its relationship to other scientific and technical areas were discussed. It was explained that, due to the fragmented nature of architecture and building activities (in contrast to the aerospace industry), a comprehensive, economic utilization of computer graphics in this area is not practical and its true potential cannot now be realized due to the present inability of architects and structural, mechanical, and site engineers to rely on a common data base. Future emphasis will therefore have to be placed on a vertical integration of the construction process and effective use of a three-dimensional data base, rather than on waiting for any technological breakthrough in interactive computing. Y.J.A.

**N76-16830*** Dayton Univ. Research Inst., Ohio.
**COCKPIT DESIGN AND EVALUATION USING INTERACTIVE GRAPHICS**
Susan M. Evans *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 361-373 refs (For availability see N76-16812 07-60)
(Contract F33615-75-C-5092)
CSCL 09B

A general overview of the characteristics of an interactive graphics system which was developed to assist cockpit engineers design and evaluate work stations was presented. The manikin used in this COMputerized Biomechanical MAN-model (COMBIMAN) was described, as are provisions for generating work stations and assessing interactions between man and environment. The applications of the present system are explained, and critiques of COMBIMAN are presented. The limitations of the existing programs and the requirements of the designers necessitate future revisions and additions to the biomechanical and erogonomic properties of COMBIMAN. Some of these enhancements are discussed. Author

**N76-16831*** Clarkson Coll. of Technology, Potsdam, N.Y.
**AN IMPROVED HUMAN DISPLAY MODEL FOR OCCUPANT CRASH SIMULATION PROGRAMS**
K. D. Willmert and T. E. Potter (Xerox Corp., Webster, N. Y.) *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 375-386 refs (For availability see N76-16812 07-60)
(Contract N00014-70-A-0311-0003)
CSCL 09B

An improved three-dimensional display model of a human being which can be used to display the results of three-dimensional simulation programs that predict the positions of an occupant during impact of a vehicle was presented. The model allows the user to view the occupant from any orientation in any position during the crash. The display model assumes the usual break up of the body into rigid segments which is normal for occupant crash simulation programs, but the shape of the segments in the display model are not necessarily the same as those used in the crash simulation. The display model is proportioned so as to produce a realistic drawing of the human body in any position. Joints connecting the segments are also drawn to improve realism. Author

**N76-16832*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A FLEXIBLE FLIGHT DISPLAY RESEARCH SYSTEM USING A GROUND-BASED INTERACTIVE GRAPHICS TERMINAL**
Jack J. Hatfield, Henry C. Elkins, Vernon M. Batson, and William L. Poole *In its* Appl. of Computer Graphics in Eng. 1975 p 387-418 refs (For availability see N76-16812 07-60)
CSCL 09B

Requirements and research areas for the air transportation

system of the 1980 to 1990's were reviewed briefly to establish the need for a flexible flight display generation research tool. Specific display capabilities required by aeronautical researchers are listed and a conceptual system for providing these capabilities is described. The conceptual system uses a ground-based interactive graphics terminal driven by real-time radar and telemetry data to generate dynamic, experimental flight displays. These displays are scan converted to television format, processed, and transmitted to the cockpits of evaluation aircraft. The attendant advantages of a Flight Display Research System (FDRS) designed to employ this concept are presented. The detailed implementation of an FDRS is described. The basic characteristics of the interactive graphics terminal and supporting display electronic subsystems are presented and the resulting system capability is summarized. Finally, the system status and utilization are reviewed. Author

**N76-16833*** Los Alamos Scientific Lab., N.Mex.
**THE APPLICATION OF INTERACTIVE GRAPHICS TO LARGE TIME-DEPENDENT HYDRODYNAMICS PROBLEMS**
Fred Gama-Lobo and Lynn D. Maas *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 419-425 (For availability see N76-16812 07-60)
(Contract W-7405-eng-36)
CSCL 09B

A written companion of a movie entitled 'Interactive Graphics at Los Alamos Scientific Laboratory' was presented. While the movie presents the actual graphics terminal and the functions performed on it, the paper attempts to put in perspective the complexity of the application code and the complexity of the interaction that is possible. Author

**N76-16834*** Boeing Computer Services, Inc., Seattle, Wash.
**COMPUTER GRAPHICS FOR MANAGEMENT: AN ABSTRACT OF CAPABILITIES AND APPLICATIONS OF THE EIS SYSTEM**
Barry J. Solem *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 427-446 (For availability see N76-16812 07-60)
CSCL 09B

The Executive Information Services (EIS) system, developed as a computer-based, time-sharing tool for making and implementing management decisions, and including computer graphics capabilities, was described. The following resources are available through the EIS languages: centralized corporate/gov't data base, customized and working data bases, report writing, general computational capability, specialized routines, modeling/programming capability, and graphics. Nearly all EIS graphs can be created by a single, on-line instruction. A large number of options are available, such as selection of graphic form, line control, shading, placement on the page, multiple images on a page, control of scaling and labeling, plotting of cum data sets, optical grid lines, and stack charts. The following are examples of areas in which the EIS system may be used: research, estimating services, planning, budgeting, and performance measurement, national computer hook-up negotiations. Y.J.A.

**N76-16835*** North Carolina State Univ., Raleigh.
**SURFACE FITTING THREE-DIMENSIONAL BODIES**
Fred R. DeJarnette and C. Phillip Ford, III *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 447-474 refs (For availability see N76-16812 07-60)
CSCL 09B

The geometry of general three-dimensional bodies was generated from coordinates of points in several cross sections. Since these points may not be on smooth curves, they are divided into groups forming segments and general conic sections are curve fit in a least-squares sense to each segment of a cross section. The conic sections are then blended in the longitudinal direction through longitudinal curves. Both the cross-sectional and longitudinal curves may be modified by specifying particular segments as straight lines or specifying slopes at selected points. This method was used to surface fit a 70 deg slab delta wing and the HL-10 Lifting Body. The results for the delta wing were very close to the exact geometry. Although there is no exact solution for the lifting body, the surface fit generated a smooth surface with cross-sectional planes very close to prescribed coordinate points. Author

**N76-16836*** Pratt and Whitney Aircraft, East Hartford, Conn.
**ENGINEERING COMPUTER GRAPHICS IN GAS TURBINE ENGINE DESIGN, ANALYSIS AND MANUFACTURE**
Richard S. Lopatka *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 475-493 refs (For availability see N76-16812 07-60)
CSCL 09B

A time-sharing and computer graphics facility designed to provide effective interactive tools to a large number of engineering users with varied requirements was described. The application of computer graphics displays at several levels of hardware complexity and capability is discussed, with examples of graphics systems tracing gas turbine product development, beginning with preliminary design through manufacture. Highlights of an operating system stylized for interactive engineering graphics is described. Author

**N76-16837*** General Dynamics/Pomona, Calif.
**PACKAGING PRINTED CIRCUIT BOARDS: A PRODUCTION APPLICATION OF INTERACTIVE GRAPHICS**
Walter A. Perrill *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 495-519 (For availability see N76-16812 07-60)
CSCL 09B

The structure and use of an Interactive Graphics Packaging Program (IGPP), conceived to apply computer graphics to the design of packaging electronic circuits onto printed circuit boards (PCB), were described. The intent was to combine the data storage and manipulative power of the computer with the imaginative, intuitive power of a human designer. The hardware includes a CDC 6400 computer and two CDC 777 terminals with CRT screens, light pens, and keyboards. The program is written in FORTRAN 4 extended with the exception of a few functions coded in COMPASS (assembly language). The IGPP performs four major functions for the designer: (1) data input and display, (2) component placement (automatic or manual), (3) conductor path routing (automatic or manual), and (4) data output. The most complex PCB packaged to date measured 16.5 cm by 19 cm and contained 380 components, two layers of ground planes and four layers of conductors mixed with ground planes. Y.J.A.

**N76-16838*** Houston Univ., Tex. Dept. of Computer Science.
**DESIGN AND IMPLEMENTATION OF A MEDIUM SPEED COMMUNICATIONS INTERFACE AND PROTOCOL FOR A LOW COST, REFRESHED DISPLAY COMPUTER**
James R. Phyne and Mart D. Nelson *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 521-533 refs (For availability see N76-16812 07-60)
CSCL 09B

The design and implementation of hardware and software systems involved in using a 40,000 bit/second communication line as the connecting link between an IMLAC PDS 1-D display computer and a Univac 1108 computer system were described. The IMLAC consists of two independent processors sharing a common memory. The display processor generates the deflection and beam control currents as it interprets a program contained in the memory; the minicomputer has a general instruction set and is responsible for starting and stopping the display processor and for communicating with the outside world through the keyboard, teletype, light pen, and communication line. The processing time associated with each data byte was minimized by designing the input and output processes as finite state machines which automatically sequence from each state to the next. Several tests of the communication link and the IMLAC software were made using a special low capacity computer grade cable between the IMLAC and the Univac. Y.J.A.

**N76-16839*** Boeing Computer Services, Inc., Seattle, Wash.
**BIG SYSTEM: INTERACTIVE GRAPHICS FOR THE ENGINEER**
Charles E. Quenneville *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 535-554 refs (For availability see N76-16812 07-60)
CSCL 09B

The BCS Interactive Graphics System (BIG System) approach to graphics was presented, along with several significant

engineering applications. The BIG System precompiler, the graphics support library, and the function requirements of graphics applications are discussed. It was concluded that graphics standardization and a device independent code can be developed to assure maximum graphic terminal transferability. Author

**N76-16840*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A GRAPHICS APPROACH IN THE DESIGN OF THE DUAL AIR DENSITY EXPLORER SATELLITES**
David S. McDougal *In its* Appl. of Computer Graphics in Eng. 1975 p 555-568 (For availability see N76-16812 07-60)
CSCL 09B

A computer program was developed to generate a graphics display of the Dual Air Density (DAD) Explorer satellites which aids in the engineering and scientific design. The program displays a two-dimensional view of both spacecraft and their surface features from any direction. The graphics have been an indispensable tool in the design, analysis, and understanding of the critical locations of the various surface features for both satellites. Author

**N76-16841*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A COMPUTER PROGRAM FOR FITTING SMOOTH SURFACES TO THREE-DIMENSIONAL AIRCRAFT CONFIGURATIONS**
Charlotte B. Craidon and Robert E. Smith, Jr. *In its* Appl. of Computer Graphics in Eng. 1975 p 569-586 refs (For availability see N76-16812 07-60)
CSCL 09B

A computer program developed to fit smooth surfaces to the component parts of three-dimensional aircraft configurations was described. The resulting equation definition of an aircraft numerical model is useful in obtaining continuous two-dimensional cross section plots in arbitrarily defined planes, local tangents, enriched surface plots and other pertinent geometric information; the geometry organization used as input to the program has become known as the Harris Wave Drag Geometry. Author

**N76-16842*** Sandia Labs., Livermore, Calif.
**MESH GENERATION FOR TWO-DIMENSIONAL REGIONS USING THE TEKTRONIX DVST (DIRECT VIEW STORAGE TUBE) GRAPHICS TERMINAL**
Verlan K. Gabrielson *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 587-603 ref (For availability see N76-16812 07-60)
CSCL 09B

The computer program DVMESH and the use of the Tektronix DVST graphics terminal were described for applications of preparing mesh data for use in various two-dimensional axisymmetric finite element stress analysis and heat transfer codes. Author

**N76-16843*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**AN INTERACTIVE GRAPHICS PACKAGE FOR THE AUTOMATIC NODE RENUMBERING OF FINITE ELEMENT MATRICES**
Ronald F. Boisvert (Coll. of Wm. and Mary, Williamsburg, Va.) and William G. Poole, Jr. (Coll. of Wm. and Mary, Williamsburg, Va.) *In its* Appl. of Computer Graphics in Eng. 1975 p 605-614 refs (For availability see N76-16812 07-60)
(Grant NGR-47-102-001; Contract N00014-73-A-0374-001; NR Proj. 044-459)
CSCL 09B

An interactive graphics software package which allows users to display the non-zero structure of large sparse symmetric materials was described and methods used to implement it as a portable FORTRAN callable subroutine were summarized. In particular, the system permits the display of the resulting matrix after reordering the rows and columns, with the reordering scheme either defined by the user or automatically generated by the program with the aim of reducing matrix bandwidth and profile. Although the primary application of the package has been to the finite element analysis of structures, it is equally well suited to the many other areas of engineering and science which use sparse matrices. Author

**N76-16844*** Lockheed-California Co., Burbank. Automation Development and Loft Group.
**SPACEBAR: KINEMATIC DESIGN BY COMPUTER GRAPHICS**
Richard J. Ricci *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 615-632 (For availability see N76-16812 07-60)
CSCL 09B

The interactive graphics computer program SPACEBAR, conceived to reduce the time and complexity associated with the development of kinematic mechanisms on the design board, was described. This program allows the direct design and analysis of mechanisms right at the terminal screen. All input variables, including linkage geometry, stiffness, and applied loading conditions, can be fed into or changed at the terminal and may be displayed in three dimensions. All mechanism configurations can be cycled through their range of travel and viewed in their various geometric positions. Output data includes geometric positioning in orthogonal coordinates of each node point in the mechanism, velocity and acceleration of the node points, and internal loads and displacements of the node points and linkages. All analysis calculations take at most a few seconds to complete. Output data can be viewed at the scope and also printed at the discretion of the user. Author

**N76-16845*** United Aircraft Corp., Stratford, Conn.
**SIKORSKY INTERACTIVE GRAPHICS SURFACE DESIGN/MANUFACTURING SYSTEM**
Richard Robbins *In* NASA. Langley Res. Center Appl. of Computer Graphics in Eng. 1975 p 633-640 (For availability see N76-16812 07-60)
CSCL 09B

An interactive graphics system conceived to be used in the design, analysis, and manufacturing of aircraft components with free form surfaces was described. In addition to the basic surface definition and viewing capabilities inherent in such a system, numerous other features are present: surface editing, automated smoothing of control curves, variable milling patch boundary definitions, surface intersection definition and viewing, automatic creation of true offset surfaces, digitizer and drafting machine interfaces, and cutter path optimization. Documented costs and time savings of better than six to one are being realized with this system. The system was written in FORTRAN and GSP for use on IBM 2250 CRT's in conjunction with an IBM 370/158 computer. Author

**N76-16846*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**THE DESIGN AND IMPLEMENTATION OF CRT DISPLAYS IN THE TCV REAL-TIME SIMULATION**
John B. Leavitt (Electron. Assoc., Inc., Princeton, N.J.), Syed I. Tariq (Electron. Assoc., Inc., Princeton, N.J.), and George G. Steinmetz *In its* Appl. of Computer Graphics in Eng. 1975 p 641-652 (For availability see N76-16812 07-60)
CSCL 09B

The design and application of computer graphics to the Terminal Configured Vehicle (TCV) program were described. A Boeing 737-100 series aircraft was modified with a second flight deck and several computers installed in the passenger cabin. One of the elements in support of the TCV program is a sophisticated simulation system developed to duplicate the operation of the aft flight deck. This facility consists of an aft flight deck simulator, equipped with realistic flight instrumentation, a CDC 6600 computer, and an Adage graphics terminal; this terminal presents to the simulator pilot displays similar to those used on the aircraft with equivalent man-machine interactions. These two displays form the primary flight instrumentation for the pilot and are dynamic images depicting critical flight information. The graphics terminal is a high speed interactive refresh-type graphics system. To support the cockpit display, two remote CRT's were wired in parallel with two of the Adage scopes. Y.J.A.

**N76-16847*#** Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
**TECHNICAL DESCRIPTION OF A TAPE CONTROL UNIT FOR A HONEYWELL DDP-516 MINICOMPUTER**
Oct. 1975 101 p refs

(Contract NAS9-12200)
(NASA-CR-147416; LEC-6477; JSC-10651) Avail: NTIS HC $5.50 CSCL 09B

Detailed description is presented of a digital magnetic tape control unit which interfaces up to four Ampex seven-track, magnetic tape transports to a Honeywell DDP-516 minicomputer. Author

**N76-16848#** Atomic Energy Board, Pretoria (South Africa).
**SELECTIVE DISSEMINATION OF INFORMATION WITH SPECIAL REFERENCE TO SA/INIS/SDI**
E. Butterly Oct. 1974 115 p refs
(PEL-241) Avail: ERDA Depository Libraries HC $8.75

The South Africa International Nuclear Information System SDI is described with reference to its three basic components: the data base, the program, and the users. The effectiveness of the manner of profile construction and the service offered were evaluated using recall and precision ratios as retrieval measures. It was concluded that a simple approach to the construction of profiles was the most cost-effective. NSA

**N76-16849#** California Univ., Berkeley. Lawrence Berkeley Lab.
**DESIGN TOOLS FOR DATA HANDLING SYSTEMS**
G. Ringland 31 Jan. 1975 18 p refs Presented at the Assoc. for Computing Machinery Conf., Washington, D. C.
(Contract W-7405-eng-48)
(LBL-3655; Conf-750229-2) Avail: NTIS HC $3.50

Complex data bases are now routinely accessed on line. Proper design of access procedures is vital to insuring the security of the data and that it can be recovered if necessary. The design tools discussed enable operator procedures to be charted in a way that identifies the interrelation between system recovery points and message sequences. Also described are the lower-level charts (flowcharts to describe interactive processing) used as specification for programs to be executed between recovery points. Examples are given from an order entry application. This is representative of applications which are primarily data entry and without the multitude of branching options encountered in some retrieval systems. Author (NSA)

**N76-16850#** California Univ., Berkeley. Lawrence Berkeley Lab.
**EXPERIENCES IN RESOURCE SHARING**
R. J. Harvey 20 Mar. 1975 13 p Presented at the 12th Atomic Energy Systems, Operations and Programming Assoc. Conf., St. Petersburg Beach, Fla.
(Contract W-7405-eng-48)
(LBL-3808; Conf-750342-1) Avail: NTIS HC $3.50

The sharing experiences in the Mathematics and Computing Division are described. Its historical development, the organizational structure and the computing hardware presently installed, and some budgetary criteria are presented. NSA

**N76-16851#** California Univ., Berkeley. Lawrence Berkeley Lab.
**DATA STRUCTURE CHARTING METHODS**
E. Hart and G. Ringland 31 Jan. 1975 17 p refs Presented at the Assoc. for Computing Machinery Conf., Washington, D. C.
(Contract W-7405-eng-48)
(LBL-3659; Conf-750229-1) Avail: NTIS HC $3.50

The growing importance of data base implementations, and the consequent need for describing interrelations between data elements, has highlighted the lack of tools for describing data structures. The paper describes, with examples, a charting method which was used successfully on a number of large projects. The important features are the compactness of charting methods, which enables large and complex structures to be understood, and the ability to represent also detailed structures such as the sequencing of items (occurrences) within a data element (or description). Author (NSA)

**N76-16852#** Oak Ridge National Lab., Tenn.
**ON-LINE CONVERSATIONAL RETRIEVAL SYSTEM FOR ORCHIS TEXT-ORIENTED DATA BASES: USER'S MANUAL**
V. A. Singletary Apr. 1975 72 p refs Revised
(Contract W-7405-eng-26)
(ORNL-4951-Rev-1) Avail: NTIS HC $4.50

This report is a user guide to the ORLOOK computer program. It includes descriptions of information files, methods of communication, program functions, control command syntax, and frequently used terminology. The program was developed as an integral part of the Oak Ridge computerized hierarchical information system (ORCHIS) to facilitate retrospective searches of online linear files. It executes in the timesharing teleprocessing environment of the IBM 360 Model 75 computer at the Oak Ridge National Laboratory. Subset files produced from its logical operations can be searched, combined, copied to online storage for subsequent ORCHIS manipulation, and transmitted to the user typewriter terminals or to the computer system printer for output. Author (NSA)

**N76-16853#** Sandia Labs., Albuquerque, N.Mex.
**DISTRIBUTED COMPUTING SYSTEMS AND THE TESTING LABORATORY**
T. S. Rathke 1974 11 p ref Presented at 21st Intern. Instr. Soc. of Am. Symp. Philadelphia, 19 May 1975 Sponsored by ERDA
(SAND-74-5479; Conf-750502-3) Avail: NTIS HC $4.00

Small sensor-based dedicated terminal computers sharing the resources of a central computer make the distributed minicomputer system economically appealing. The problem of attaching a dedicated satellite minicomputer to the distributed network was developed with emphasis given to the economics of the system. The problem of determining the proper communication link between the central computer and geographically dispersed satellites was developed with cases given for both hardwired and modem links. The distributed network configuration, resources allocation, communications link consideration, and system advantages are considered with specific examples as illustrations. Author (NSA)

**N76-16854#** Dornier-System G.m.b.H., Friedrichshafen (West Germany).
**MODULAR CORE MEMORY WITH LOW POWER CONSUMPTION Final Report**
M. Gaertner, F. Gliem, F. Pittermann, M. Schlenther, and J. Spencer Sep. 1975 135 p refs
(Contract ESTEC-2197/74-HP)
(ESA-CR(P)-743) Avail: NTIS HC $6.00

A 4K 16 bit memory module based on the 4K core memory used in several Helios experiments was developed. The most important feature of the memory is the very low power consumption (less than 12 W average dynamic power consumption at a cycle time of 2.5 microseconds) compared with other available core memories at the same cycle rate. The following topics are discussed: technical data, circuit description, mechanical layout, heat flow analysis, test results, and reliability analysis. Author (ESA)

**N76-16855#** TRW Environmental Services, Vienna, Va.
**SOURCE TEST DATA SYSTEM (SOTDAT) Final Report**
Jul. 1975 15 p
(Contract EPA-68-02-1007)
(PB-245052/6; EPA-450/3-75-070; Rept-96005.003) Avail: NTIS HC $3.50 CSCL 05B

The SOTDAT System permits the gathering of source test data from many places and their storage in a computer-accessible data bank in a common format. SOTDAT is designed so that each record describes, in detail, one run of a stack test. Variables included are most of those which enter into the normal stack test calculations, as well as some which will be necessary to future users of SOTDAT. Information stored in SOTDAT contains an adequate number of source parameters and concentrates heavily on data describing a specific test run. Since each SOTDAT record is keyed to a record in the National Emissions Data System (NEDS), any required source parameters are readily available from a NEDS listing. GRA

**N76-16856#** PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.
**STATUS OF NADB DATA SYSTEMS Final Report**
David W. Armentrout and Charles E. Zimmer Apr. 1975 205 p refs

(Contract EPA-68-02-1375)
(PB-245009/6; EPA-450/3-75-065) Avail: NTIS HC $7.75 CSCL 05B

The results of a survey conducted among the Regional Offices of the U. S. Environmental Protection Agency and other EPA users of the National Air Data Branch (NADB) systems are presented. Included are recommendations for improving the current NADB systems to make them more responsive to users and detailed requirements for new programs are outlined. Costs for implementating each suggestion are estimated. GRA

**N76-16857#** Michigan Univ., Ann Arbor. Performance Modeling Group.
**COMPUTER SYSTEM MODELS Final Report, 1 Mar. 1971 - 31 Aug. 1974**
Stephen R. Kimbleton (Univ. of Southern Calif., Maria del Rey) 30 May 1975 29 p refs
(Contract N00014-67-A-0181-0036; NR Proj. 049-311)
(AD-A014930) Avail: NTIS CSCL 09/2

The primary objective of this contract was development of a coherent model based approach to computer system design and control. The first requirement for development of such an approach is observation of the distinction between organizational issues (which must be resolved on a site-by-site basis), and technological issues (which are amenable to centralized resolution). First order technological issues are shown to factor into four major categories: hardware configuration, software capabilities, system scheduling and file-device assignment. An integrated research effort covering these four areas is described in this report. In addition, a feasibility demonstration is provided which indicates that resolution of issues in the first three categories can be best achieved through use of a heuristic approach. In contrast, algorithmic approaches for resolution of the file-device assignment problem are in order. GRA

**N76-16858#** Massachusetts Inst. of Tech., Cambridge.
**PACKET COMMUNICATION ARCHITECTURE**
Jack B. Dennis Aug. 1975 10 p refs
(Contract N00014-75-C-0661)
(AD-A014956; MAC-CSG-M-130) Avail: NTIS CSCL 09/2

Packet Communication Architecture is the structuring of data processing systems as collections of physical units that communicate only by sending information packets of fixed size, using an asynchronous protocol. Each unit is designed so it never has to wait for a response to a packet it has transmitted to another unit while other packets are waiting for its attention. Packets are routed between sections of a system by networks of units arranged to sort many packets concurrently according to their destination. In this way, it is possible to arrange that system units are heavily used provided concurrency in the task to be performed can be exploited. The packet communication principle is especially attractive for data flow processors since the execution of data flow programs readily separates into many independent computational events. In this paper it is shown how packet communication can be used in the architecture of memory systems capable of processing many independent memory transactions concurrently and having hierarchical structure. The behavior of these memory systems is prescribed by a formal memory model appropriate to a computer system for data flow programs. GRA

**N76-16859#** Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
**THEORY OF FAULT TOLERANCE Annual Report, Aug. 1974 - Aug. 1975**
L. A. Jack, W. L. Heimerdinger, and M. D. Johnson 22 Sep. 1975 117 p refs
(Contract N00014-75-C-0011)
(AD-A014935; F0326-74) Avail: NTIS CSCL 09/2

The first phase of a long range program to develop a theoretical base for the design and evaluation of fault tolerant digital systems is summarized. The purpose of this effort was to investigate the feasibility of representing fault tolerant phenomena with two existing Labeled Graph models, LOGOS and Petri Nets. LOGOS and Petri Net models were used to represent systems at a functional level. Functional faults were hypothesized to describe the effect of a fault mechanism from a functional viewpoint. Functional faults were found to provide high leverage over traditional 'Stuck-At-One' or 'Stuck-At-Zero' analysis. Models were developed which describe: (1) The non-faulty system function; (2) The faulty system operation; (3) Fault detection techniques; and (4) Fault recovery schemes. The results of modeling several candidate fault tolerant system problems reaffirmed our belief in the utility of Labeled Graphs as a representation language for fault tolerant phenomena. We found both models concisely described the structure and dynamics of a control system and provided insight into the effect of fault detection and recovery mechanisms on a given fault mechanism. GRA

**N76-16860#** Defense Dept., Washington, D.C.
**FEATURE ANALYSIS OF CODASYL DATA BASE**
Tom Warren 25 Jun. 1975 114 p refs
(AD-A014972) Avail: NTIS CSCL 09/2

The CODASYL specifications, it is generally assumed, represent currently the most viable approach towards developing commonality among data base management systems. Though it is still a long way from becoming a standard, implementations based on the CODASYL specifications may significantly diminish the problems associated with data base sharing and portability of programs between heterogeneous computer systems, problems which are becoming more prevalent with the advent of computer networking. This report will look in detail at four systems of the CODASYL family. Their features will be outlined to allow a judgement on the commonality that exists with the CODASYL approach. The four systems are DBMS-10, available from Digital Equipment Corporation on the PDP-10; IDMS, marketed by the Cullinane Corporation and running primarily on IBM equipment; DMS 1100, a Univac product on the 1100 series; and EDMS by Xerox, implemented on its Sigma and 560 series. GRA

**N76-16861#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
**A CDC 6600-BASED CROSS-ASSEMBLER FOR THE DEC PDP8 MINICOMPUTER Final Technical Report**
Barry J. Brownstein Jul. 1975 110 p
(AD-A015060; AFAPL-TR-75-30) Avail: NTIS CSCL 09/2

One of the difficulties in programming a minicomputer with a minimum complement of peripheral devices is the need to use paper tape software. This software is normally ponderous to use, provides a minimum of diagnostics, and very little language modification capability. The cross-assembler described in this report runs on the CDC 6600, using higher speed peripherals, card input, and is used very much like an assembly language for a large computer system, such as COMPASS. GRA

**N76-16862#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
**THE DESIGN OF A DATA ACQUISITION OPERATING SYSTEM FOR THE DEC PDP8**
Barry J. Brownstein Jul. 1975 118 p
(AF Proj. 3066)
(AD-A015032; AFAPL-TR-75-29) Avail: NTIS CSCL 09/2

This report contains the details of the development of an unbuffered, fixed task, data acquisition operating system for a Digital Equipment Corporation PDP8 minicomputer. As the PDP8 is one of the oldest minicomputers in wide use, and because of its straight-forward architecture, it is felt that a detailed description of the operating system might help to isolate the design process more so than would the discussion of a similar system on a more sophisticated processor. Author (GRA)

**N76-16863#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
**A CDC 6600-BASED CROSS-ASSEMBLER FOR THE HP2114 MINICOMPUTER Final Report**
Barry J. Brownstein Jul. 1975 116 p
(AD-A015033; AFAPL-TR-75-31) Avail: NTIS CSCL 09/2
For abstract, see N76-16861.

**N76-16864#** Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
**THE ECLECTIC SIMULATOR PROGRAM (ESP) USAGE GUIDE Interim Report, 1 Jul. 1968 - 30 Jun. 1975**
Emmagene R. Coffey and Harvey J. Wertz 30 Jun. 1975 184 p refs
(Contract F04701-74-C-0075)
(AD-A014822; TR-0075(9320)-5; SAMSO-TR-75-201) Avail:

NTIS CSCL 09/2

The Eclectric Simulator Program (ESP) is a system (a precompiler plus a collection of subroutines) that permits the fast, easy solution of ordinary differential equations. Any user with a general knowledge of FORTRAN can utilize ESP's many labor-saving devices to code a problem with minimal effort. Special ESP features permit translation of engineering blocks, discontinuities, and hysteresis patterns directly into computer code, and the use of WHELP in conjunction with ESP facilitates efficient coding of matrix algebra equations. Simple input cards enable the user to directly control solution and timing accuracy and to specify or change run times, initial conditions, and various other parameters easily when making multiple or stacked runs. Finally, ESP allows the user to select from a wide variety of output options. This manual is intended to be both a learning tool for the novice and a detailed reference for the experienced user.

Author (GRA)

**N76-16865#** University of Southern Calif., Marina del Rey. Information Sciences Inst.

**A TUTORIAL FOR USE OF THE TENEX ELECTRONIC NOTEBOOK-CONFERENCE (TEN-C) SYSTEM ON THE ARPANET Research Report, 15 Apr. - 15 Jul. 1975**

James H. Carlisle 31 Jul. 1975 48 p refs

(Contract N00014-75-C-0710; ARPA Order 2930; NR Proj. 154-374)

(AD-A014622; ISI/RR-75-38) Avail: NTIS CSCL 09/2

This report describes a tutorial for introducing novice users to a collection of computer programs which support interpersonal communication. The tutorial is designed to reduce the apparent complexity of the multiple command languages involved. The instructional strategy used provides a model for other training situations in which a collection of computer programs must be taught simultaneously. The tutorial first presents concepts which facilitate understanding of the various command languages. This is followed by a series of exercises leading up to the new user's performance of a sample task involving a limited subset of all commands. The tutor monitors the new user's progress and offers advice. This approach puts the new user in an active, problem-solving role from the beginning. The collection of programs described in this tutorial is called the Tenex Electronic Notebook-Conference (TEN-C) System. Included in this 'system' are the XED text editor, the MSG message handling program, the ZCONFER conferencing program (a modification of FORUM 5). These programs operate under the TENEX executive on the PDP-10 computers at the USC/Information Sciences Institute.

GRA

# 61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

**N76-16866#** California Univ., Berkeley. Lawrence Berkeley Lab.

**SOFTWARE IN RESOURCE SHAPING: SCIENTIFIC**

D. F. Stevens Mar. 1975 10 p Presented at the 12th Atomic Energy Systems, Operations, and Programming, Assoc. Conf., St. Petersburg Beach, Fla.

(Contract W-7405-eng-48)

(LBL-3801; Conf-750342-2) Avail: NTIS HC $3.50

The problem addressed is the simultaneous usage of and access to the computer system by several agencies, whether locally resident or geographically scattered, and how this affects the programming, documentation, and people using and maintaining a wide-open establishment. It is concluded that there are no hidden technical software problems to be encountered in resource sharing in such an environment.

NSA

**N76-16867#** National Physical Lab., Teddington (England). Div. of Numerical Analysis.

**SOAP - SIMPLIFY OBSCURE ALGOL PROGRAMS**

R. S. Scowen Apr. 1975 46 p refs

(NPL-NAC-60) Avail: NTIS HC $4.00

SOAP is a program which displays the text of an ALGOL 60 program in a clear, standard way. There are many different versions, some machine-independent and written in ALGOL 60, others adapted for special ALGOL dialects. The latest developments include a new machine-independent version called SOAP-Plus and improved methods of editing long lines and comments. All information is collected on SOAP which is still relevant and describes the various versions, their implementation and how SOAP fails when it is given an incorrect program as data. A brief history of SOAP and a list of other implementations are given.

Author (ESA)

**N76-16868#** National Physical Lab., Teddington (England). Div. of Computer Science.

**EASI 80: AN EDITOR, ASSEMBLER AND SIMULATOR FOR THE INTEL 8080 MICROPROCESSOR**

B. J. Chorley and Susan E. Olding Sep. 1975 48 p Sponsored by Computer Systems and Electron. Board

(NPL-Com-80) Avail: NTIS HC $4.00

The EASI 80 system was written to enable programs for the Intel 8080 microprocessor to be cross-assembled on a larger machine. The source program may be edited, assembled, and simulated on the DDP516 host computer. In this way the program may be debugged more easily. Pseudo-operations, which are also available, help to speed up the program working process.

ESA

**N76-16869#** Air Force Academy, Colo.

**ANALYZE USER'S MANUAL Final Report, Feb. - May 1975**

Thomas E. McCann May 1975 49 p refs

(AD-A014785; USAFA-TR-75-2A) Avail: NTIS CSCL 05/9

The manual describes a FORTRAN computer program, ANALYZE, and the proper techniques for using the program on the Burroughs 6700 computer at the USAF Academy. ANALYZE was designed to give academic grade statistics and grade distributions for the sophomore physics course at the USAF Academy. Included in the report are a program listing, proper input techniques and sample output.

GRA

**N76-16870#** Colorado State Univ., Fort Collins. Engineering Research Center.

**COMPUTER PROGRAMS FOR SEDIMENT TRANSPORT, DOCUMENTATION AND LISTING Final Report**

Khalid Mahmood and V. Miguel Ponce Aug. 1975 101 p refs

(Grant NSF ENG-72-00274)

(PB-244838/9; CER75-76KM-VMP2) Avail: NTIS HC $5.50 CSCL 08H

Five FORTRAN programs for the computation of sediment transport are presented in the form of a reference manual with documentation and listing included. The programs deal with the following methods: (1) Einstein Bed-Load Function, (2) Mahmood's Bed Material Transport Function, (3) Colby's Bed Material Load method, (4) Meyer-Peter and Muller Bed-Load Equation, and (5) modified Einstein procedure. The programs are written in FORTRAN IV language and have been extensively tested on the CDC 6400 Computer at the Colorado State University using Scope 3.3.

GRA

**N76-16871#** Polytechnic Inst. of New York, Brooklyn. Dept. of Electrical Engineering and Electrophysics.

**COMPUTER SOFTWARE RELIABILITY: MANY-STATE MARKOV MODELING TECHNIQUES Interim Report, Apr. 1974 - Apr. 1975**

Ashok K. Trivedi and Martin L. Shooman Jul. 1975 311 p refs

(Contract F30602-74-C-0294; AF Proj. 5550)

(AD-A014824; POLY-EE/EP-75-005; POLY-EER-116; RADC-TR-75-169) Avail: NTIS CSCL 09/2

Many-state Markov models have been developed for the purpose of providing quantitative reliability criteria for computer software. The software system under consideration is assumed to be large, so that statistical deductions become meaningful, and is assumed to initially contain an unknown number of bugs. The basic models provide estimates and predictions for a quantifier that represents the state of debugging of the system and which is generally the most probable number of software errors that will have been corrected at a given time in the

operation of this software system based upon preliminary modeling of the error occurrence rate and the error correction rate. The models also provide predictions for the availability and for the reliability of the system. The differential equations corresponding to the basic many-state Markov models are solved for verification and demonstrative purposes. Manufacturer's data have been obtained on this performance of system software for a medium-sized software operating system. These data have been analyzed to obtain frequency distributions of the random variables representating the time to close software error reports. The data are then used for application of the basic many-state Markov model. A general discussion of error data collection is undertaken in some detail, and suggestions are made for possible improvements in software error data documentation practices. GRA

**N76-16872#** Harvard Univ., Cambridge, Mass.
**RESEARCH IN PROGRAM OPTIMIZATION TECHNIQUES Technical Report, 1 Jun. 1974 - 31 May 1975**
Thomas E. Cheatham, Jr. 30 Jun. 1975 29 p refs
(Contract F19628-74-C-0208)
(AD-A015041; ESD-TR-75-81) Avail: NTIS CSCL 09/2

In the context of the ECL programming system, general techniques for program optimization at high levels of language and special purpose techniques to enhance use of ECL for systems programming have been studied. The specific problems discussed are the efficient representation of knowledge about programs, the use of measurements to guide program improvement, compiler optimization under strict resource constraints and user control of machine level code optimizations such as register assignment. Author (GRA)

**N76-16873#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**LOADER: A CHARACTER MANIPULATION PROGRAM FOR AUTOMATIC CODE WRITING Final Report**
M. D. Kregel, J. M. Heimerl, and E. L. Lortie Aug. 1975 99 p refs
(DA Proj. 1T1-62111-AH-71)
(AD-A014877; BRL-1814) Avail: NTIS CSCL 09/2

LOADER is a symbolic character manipulation program which automatically generates appropriate FORTRAN language expressions for the temporial derivatives associated with a given chemical reaction set as well as the derivatives associated with corresponding Jacobian matrix. The program and its operation are described in sufficient detail to permit the reader to adopt or adapt all or any portion of it for his own code writing requirements. Author (GRA)

**N76-16874#** Aerospace Corp., El Segundo, Calif. Technology Div.
**AUTOMATED AIDS FOR RELIABLE SOFTWARE**
D. J. Reifer 26 Aug. 1975 53 p refs
(Contract F04701-74-C-0075)
(AD-A014821; TR-0075(5112)-6; SAMSO-TR-75-183) Avail: NTIS CSCL 09/2

Recent investigations on the use of automation to realize the twin objectives of cost reduction and reliability improvement for computer programs developed for the U. S. Air Force are reported. The concepts of reliability and automation as they pertain to software are explained. Then, over twenty automated tools and techniques (aids) identified by this investigation are described and categorized. Based on the information reviewed, an assessment of the state of the technology is made. Finally, specific recommendations which try to give direction to future efforts are offered. Author (GRA)

# 62 COMPUTER SYSTEMS

Includes computer networks.

No abstracts in this category.

# 63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

**N76-16875#** Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
**LIKELIHOOD RATIOS FOR SEQUENTIAL DECISION-MAKING ON MARKOV SEQUENCES**
Louis L. Scharf and Loren W. Nolte Aug. 1975 37 p refs Prepared in cooperation with Duke Univ.
(Contracts N00014-75-C-0518; N00014-67-A-0299-0019)
(AD-A014667; ONR-TR-13) Avail: NTIS CSCL 09/4

The purpose of this research is to derive a variety of likelihood ratios for the detection of Markov sequences in noise. The program consists of exploiting the Bayesian recursions appropriate to a related filtering problem, together with a 'known-form' likelihood ratio, to obtain the desired result. In the derivation of a discrete-time Gauss-Markov likelihood ratio the authors seek a 'pure' causal estimator-correlator structure and encounter a 'locally stable' state estimator that is of some interest in its own right. The likelihood ratio is 'pure' in the sense that the locally stable estimator is used in precisely the same manner as the stored replica in a known-form detection problem. The estimator is 'locally stable' in the sense that it equalizes within a constant related to the a priori and a posteriori filtering error covariances, the prior and a posteriori filtering densities. GRA

# 64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

**N76-16876** Arizona State Univ., Tempe.
**ON THE ASYMPTOTIC BEHAVIOR OF SOLUTIONS TO PERTURBED LINEAR DIFFERENTIAL EQUATIONS Ph.D. Thesis**
David Eric Brown 1975 65 p
Avail: Univ. Microfilms Order No. 75-29913

The asymptotic behavior of solutions of perturbed linear equations in which the perturbing term is nonlinear is studied. A theorem which establishes, under certain conditions, the existence of a solution to a perturbed nonsingular linear equation is given. The proof of this theorem also offers an estimate of the asymptotic size of the difference between the solution of the perturbed equation and the solution of the corresponding linear equation which is the basis of most of the following work. Based upon this, facts concerning constant coefficient equations are used to obtain results on the asymptotic behavior of solutions to perturbed constant coefficient equations; these results are particularized to a perturbation of the equation $y(n) = 0$. Finally, similar techniques and a monotone bound are used for the perturbing term to obtain a result for the perturbed equation $y(n) + B(x,y,y',\ldots, y,\ldots, (n-1) = 0$ which permits a partial converse. Dissert. Abstr.

**N76-16877** Northwestern Univ., Evanston, Ill.
**FINITE DIFFERENCE APPROXIMATION TO THE FREE BOUNDARY OF A PARABOLIC VARIATIONAL INEQUALITY Ph.D. Thesis**
Robert Ronald Jensen 1975 82 p
Avail: Univ. Microfilms Order No. 75-29666

A second order parabolic variational inequality in the strip R x (0,T) is considered. Under some conditions of the inhomogeneous term, of the coefficients of the parabolic operator, and of the initial data, it is proved that the free boundary consists of two continuous curves. Dissert. Abstr.

**N76-16878#** Carnegie-Mellon Univ., Pittsburgh, Pa. Management Science Research Group.
**A LIFO IMPLICIT ENUMERATION ALGORITHM FOR THE ASYMMETRIC TRAVELING SALESMAN PROBLEM USING A ONE-ARBORESCENCE RELAXATION Technical Report, Oct. 1975**

Theunis H. C. Smith Oct. 1975 20 p refs Sponsored by CSIR
(MSRR-380; WP-30-75-76) Avail: NTIS HC $3.50

A LIFO implicit enumeration algorithm was proposed for the asymmetric traveling salesman problem in which the one-arborescence relaxation of the traveling salesman problem (orginally suggested by Held and Karp) is employed as a fathoming device. The efficient Edmonds-Fulkerson algorithm is used to construct minimum-cost arborescences. Computational experience with the algorithm is also presented. Author

**N76-16879#** Ames Lab., Iowa.
**ITERATIVE METHOD FOR FREDHOLM EQUATIONS OF THE FIRST KIND Ph.D. Thesis - Iowa State Univ.**
William Carl Peterson May 1975 115 p refs
(Contract W-7405-eng-82)
(IS-T-675) Avail: NTIS HC $5.50

An iterative method is developed to find an approximation to the least squares solution of minimum norm, f0, of an operator equation, Kf equals g, of the first kind. In applications to integral equations, the superfluous oscillations in the final solution of methods in the literature are not an apparent problem. Letting K: H1 yields H2 be a completely continuous operator from a real separable Hilbert space H1 to a real Hilbert space H2, a sequence converging to f0 is constructed, and stability and error bounds are obtained. Author (NSA)

**N76-16880#** Stanford Univ., Calif. Dept. of Computer Science.
**ON SUBGRAPH NUMBER INDEPENDENCE IN TREES**
R. L. Graham (Bell Telephone Labs., Murray Hill, N. J.) and E. Szemeredi (Hung. Acad. Sci.) Mar. 1975 20 p refs
(Grant NSF GJ-36473; NR Proj. 044-402)
(AD-A011832; STAN-CS-75-484) Avail: NTIS CSCL 12/1

In any finite tree T, the number of vertices of T always exceeds the number of edges of T by exactly 1. Theorems and proofs that show to what extent this relationship occurs in graphs (in general) are given and discussed. Author (GRA)

**N76-16881#** Stanford Univ., Calif. Dept. of Computer Science.
**ON MULTIPLICATIVE REPRESENTATIONS OF INTEGERS**
P. Erdos (Hung. Acad. Sci.) and E. Szemeredi (Hung. Acad. Sci.) Mar. 1975 20 p refs
(Grant NSF GJ-36473; NR Proj. 044-402)
(AD-A011834; STAN-CS-75-485) Avail: NTIS CSCL 12/1

Two results were proved in relation to multiplicative representations of integers for which the products are all distinct. These results were concerned with setting upper bounds on the product k1, where k and 1 refer respectively to the number of integers in two distinct bound sets. The resulting bounds were expressed as a function of x, the upper bound of the integers in the two sets, the logarithm of x, and some constants. Y.J.A.

**N76-16882#** Stanford Univ., Calif. Dept. of Computer Science.
**REGULAR PARTITIONS OF GRAPHS**
E. Szemeredi (Hung. Acad. Sci.) Apr. 1975 12 p ref
(Grant NSF GJ-36473; NR Proj. 044-402)
(AD-A011833; STAN-CS-75-489) Avail: NTIS CSCL 12/1

A crucial lemma in recent work of the author (showing that k-term arithmetic progression-free sets of integers must have density zero) stated (approximately) that any large bipartite graph can be decomposed into relatively few 'nearly regular' bipartite subgraphs. In this note the author generalizes this result to arbitrary graphs, at the same time strengthening and simplifying the original bipartite result. GRA

**N76-16883#** Office of Telecommunications, Boulder, Colo.
**A METHOD OF BIVARIATE INTERPOLATION AND SMOOTH SURFACE FITTING FOR VALUES GIVEN AT IRREGULARLY DISTRIBUTED POINTS**
Hiroshi Akima Aug. 1975 56 p refs
(COM-75-11285/4; OTR-75-70) Avail: NTIS HC $4.50 CSCL 12A

The interpolating function is a fifth-degree polynomial in x and y defined in each triangular cell which has projections of three data points in the x-y plane as its vertexes. Each polynomial is determined by the given values of z and estimated values of partial derivatives at the vertexes of the triangle. Procedures for dividing the x-y plane into a number of triangles, for estimating partial derivatives at each data point, and for determining the polynomial in each triangle are described. A simple example of the application of the proposed method is shown. User information and FORTRAN listings are given on a computer subprogram package that implements the proposed method. GRA

# 65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**N76-16884*#** Wisconsin Univ., Madison. Dept. of Statistics.
**MEASURES AND MODELS FOR ANGULAR CORRELATION AND ANGULAR-LINEAR CORRELATION**
Richard A. Johnson and Thomas Wehrly Jan. 1976 32 p refs
(Grant NsG-1196)
(NASA-CR-146354; TR-434) Avail: NTIS HC $4.00 CSCL 12A

Population models for dependence between two angular measurements and for dependence between an angular and a linear observation are proposed. The method of canonical correlations first leads to new population and sample measures of dependance in this latter situation. An example relating wind direction to the level of a pollutant is given. Next, applied to pairs of angular measurements, the method yields previously proposed sample measures in some special cases and a new sample measure in general. Author

**N76-16885*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**STOCHASTIC PROCESS APPROXIMATION FOR RECURSIVE ESTIMATION WITH GUARANTEED BOUND ON THE ERROR COVARIANCE**
Guiseppe Menga Sep. 1975 25 p refs
(NASA-TM-X-73078; A-6295) Avail: NTIS HC $3.50 CSCL 12A

An approach, is proposed for the design of approximate, fixed order, discrete time realizations of stochastic processes from the output covariance over a finite time interval, was proposed. No restrictive assumptions are imposed on the process; it can be nonstationary and lead to a high dimension realization. Classes of fixed order models are defined, having the joint covariance matrix of the combined vector of the outputs in the interval of definition greater or equal than the process covariance; (the difference matrix is nonnegative definite). The design is achieved by minimizing, in one of those classes, a measure of the approximation between the model and the process evaluated by the trace of the difference of the respective covariance matrices. Models belonging to these classes have the notable property that, under the same measurement system and estimator structure, the output estimation error covariance matrix computed on the model is an upper bound of the corresponding covariance on the real process. An application of the approach is illustrated by the modeling of random meteorological wind profiles from the statistical analysis of historical data. Author

**N76-16886#** Technology, Inc., Dayton, Ohio.
**ON THE DISTRIBUTIONS OF THE LIKELIHOOD RATIO STATISTICS FOR TESTS OF CERTAIN COVARIANCE STRUCTURES OF COMPLEX MULTIVARIATE NORMAL POPULATIONS Interim Report**
J. C. Lee, T. C. Chang, and P. R. Krishnaiah Jun. 1975 45 p refs
(Contract F33615-73-C-4155; AF Proj. 7071)
(AD-A014734; ARL-75-0169) Avail: NTIS CSCL 12/1

In this report, the authors approximated the distributions of the likelihood ratio statistics for testing certain hypotheses in multivariate analysis with suitable Pearson type distributions. Using these approximations, they have constructed extensive tables and illustrated the usefulness of these tables with the data on the vibrations of a C-5A aircraft. The hypotheses that are considered include the hypotheses of sphericity, multiple

independence, multiple homogeneity of covariance matrices when the underlying distributions are complex multivariate normal.
GRA

**N76-16887#** Technology, Inc., Dayton, Ohio.
**APPROXIMATIONS TO THE DISTRIBUTIONS OF THE LIKELIHOOD RATIO STATISTICS FOR TESTING CERTAIN STRUCTURES ON THE COVARIANCE MATRICES OF REAL MULTIVARIATE NORMAL POPULATIONS Interim Report**
J. C. Lee, T. C. Chang, and P. R. Krishnaiah Jun. 1975 58 p refs
(Contract F33615-73-C-4155; AF Proj. 7071)
(AD-A014733; ARL-75-0167) Avail: NTIS CSCL 12/1

In this report, the authors approximated the distributions of the likelihood ratio statistics for testing certain hypotheses on the covariance matrices of the multivariate normal populations by using suitable Pearson type distributions. The hypotheses that are considered include the hypotheses of sphericity, multiple homogeneity of covariance matrices and multiple independence. Using these approximations, tables of percentage points of the distributions considered are constructed. The accuracy of these tables is sufficient for practical purposes. GRA

**N76-16888#** Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
**CONVERGENCE RESULTS FOR ADAPTIVE FILTERING WITH CORRELATED DATA Ph.D. Thesis**
David C. Farden and Louis L. Scharf Aug. 1975 39 p refs Submitted for publication
(Contracts N00014-75-C-0518; N00014-67-C-0299; N66001-72-C-0479; N000123-73-C-1375; N66001-74-C-0035; N66001-75-C-0024)
(AD-A014851; TR-15) Avail: NTIS CSCL 09/4

New almost sure convergence results for a special form of the multidimensional Robbins-Monro stochastic approximation procedure are given. The results are applicable to cases where the 'training data' is heavily correlated. No conditional expectation properties or bounded assumptions are required to apply the new results. For example, when the data sequence is normal and (1) M-dependent, (2) autoregressive moving average (ARMA), or (3) 'band-limited', the results can be used to establish the almost sure convergence of each algorithm treated. The special form of the Robbins-Monro procedure considered is motivated by a consideration of several algorithms that have been proposed for discrete time adaptive signal processing applications. Most of these algorithms can also be viewed as stochastic gradient-following algorithms. Several examples are presented to illustrate the applicability of the convergence results. GRA

# 66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

**N76-16889** State Univ. of New York, Stony Brook.
**TIME PARTITIONED ESTIMATION Ph.D. Thesis**
Charles Ralph Waters, Jr. 1975 200 p
Avail: Univ. Microfilms Order No. 76-791

Time partitioned estimation involves a design concept that utilizes the inherent time divisions within a system to reduce the amount of computation required to generate the estimates of the proper quantities at the rates needed. The structures of both the Luenberger Observer and Kalman Filter require that state estimates be formed at the input measurement times. Fast measurement rates in combination with a large number of states can result in a difficult computational problem. Often in large systems, the state estimates are not needed at the same rates. Therefore, by constructing several small estimators operating at different rates and using the estimates of the slower observers as measurements for the faster ones, the computational burdens can be reduced. The concept of time partitioning by investigating the general structures and properties of such estimation schemes was developed. Dissert. Abstr.

**N76-16890** Purdue Univ., Lafayette, Ind.
**STEADY-STATE ANALYSIS OF LINEAR NETWORKS CONTAINING TIME-VARYING ELEMENTS Ph.D. Thesis**
Chong Khim Koh 1975 115 p
Avail: Univ. Microfilms Order No. 76-551

A computational method of steady-state analysis of linear time-varying networks with periodic time variation is presented. The dynamic dimension of the network is only required to be finite and the periodic elements must be characterized by finite trigonometric polynomials. The frequency-domain equations which describe the above networks are linear inhomogeneous difference equations with variable coefficients. An algorithm is presented for generating a fundamental system of solutions to the homogeneous equation. These fundamental solutions possess asymptotic properties. The particular solutions were found by the method of variation of parameters from which the steady-state response was obtained. A computer program was written for carrying out the steady-state analysis. The estimation of the error in the numerical solutions is given. Numerical examples are included to illustrate the application of the algorithm.
Dissert. Abstr.

**N76-16891** California Univ., Los Angeles.
**QUEUEING NETWORK MODELS FOR COMPUTER SYSTEMS Ph.D. Thesis**
Johnny Wai-Nang Wong 1975 254 p
Avail: Univ. Microfilms Order No. 76-1172

Queueing network models are used for performance studies of computer systems. The basic model under consideration is a closed network representing N terminal users competing for the use of a set of processing resources. With the assumption that all users are statistically identical, asymptotic expressions are derived for performance measures such as resource utilization and mean response time when N is large. These expressions characterize the behavior of the system as N increases. They have the important advantage that (1) they are simple functions of the model parameters, and (2) they apply to models that do not yield to exact analysis. For the basic model, formal definitions are also given to terms like limiting resource, system saturation, and system balance. A limited memory model is then used to study the effect of memory limitations on the asymptotic properties of resource utilization and mean response time.
Dissert. Abstr.

**N76-16892*#** Aerospace Corp., El Segundo, Calif. Advanced Mission Analysis Directorate.
**SYSTEMS COST PERFORMANCE ANALYSIS (STUDY 2.3). VOLUME 1: EXECUTIVE SUMMARY Final Report**
31 Mar. 1975 36 p refs Supersedes ATR-74(7343)-1-Vol-1
(Contract NASw-2727)
(NASA-CR-146133; ATR-75(7363)-3-Vol-1; ATR-74(7343)-1-Vol-1) Avail: NTIS HC $4.00 CSCL 12B

A methodology for developing balanced designs of spacecraft subsystems which interrelates cost, performance, safety, and schedule considerations was developed. The methodology consists of a two-step process: selection of all hardware designs which satisfy the given performance and safety requirements; and estimating the cost and schedule required to design, build, and operate each spacecraft design. Aggregate equations were written to describe the performance, safety (reliability), cost, and schedule required for one type of stabilization and control subsystem in terms of the equipment used. The methodology was applied to unmanned, automated spacecraft subsystems, and the resulting model was implemented as a digital computer program. Author

**N76-16893*#** Aerospace Corp., El Segundo, Calif. Advanced Mission Analysis Directorate.
**SYSTEMS COST/PERFORMANCE ANALYSIS (STUDY 2.3). VOLUME 2, APPENDIX A: DATA BASE Final Report**
31 Mar. 1975 395 p Supersedes ATR-74(7343)-1-Vol-1-App-A
(Contract NASw-2727)
(NASA-CR-146131; ATR-74(7343)-1-Vol-1-App-A; ATR-75(7363)-3-Vol-2-App-A) Avail: NTIS HC $10.75 CSCL 12B

Data on selected payload equipments (components) which were collected for the purpose of exercising the systems cost performance model are reported in an appendix. The reader should be aware that, although most of the data are accurate, approximations based on engineering judgment and experience

are used wherever actual data were unavailable. The approximations are justified by the objective of the study which was to develop a cost/performance model. Assuming that the model is successfully developed and is accepted for use by a body of users, the data base should be expanded and the approximations replaced by actual data. Author

**N76-16894*#** Aerospace Corp., El Segundo, Calif. Advanced Mission Analysis Directorate.
**SYSTEMS COST/PERFORMANCE ANALYSIS; STUDY 2.3. VOLUME 3: PROGRAMMER'S MANUAL AND USER'S GUIDE Final Report**
31 Mar. 1975 782 p Supersedes ATR-74(7343)-1-Vol-1
(Contract NASw-2727)
(NASA-CR-146130; ATR-75(7363)-3-Vol-3; ATR-74(7343)-1-Vol-1) Avail: NTIS HC $18.75 CSCL 12B

The implementation of the entire systems cost/performance model as a digital computer program was studied. A discussion of the operating environment in which the program was written and vhecked, the program specifications such as discussions of logic and computational flow, the different subsystem models involved in the design of the spacecraft, and routines involved in the nondesign area such as costing and scheduling of the design were covered. Preliminary results for the DSCS-2 design are also included. Author

**N76-16895#** United Kingdom Atomic Energy Authority, Warrington (England). Systems Reliability Service.
**INTRODUCTION TO RELIABILITY CONCEPTS IN SYSTEMS ANALYSIS FOR SPACE APPLICATIONS**
Sep. 1975 160 p refs
(Contract ESTEC-1824/72-HP)
(SRS/ASG/1031; ESA-CR(P)-736) Avail: NTIS HC $6.75

Reliability studies are dealt with for the purpose of providing an overall reliability approach to space problems and an illustration of a methodology using a logical approach in formulating and assessing the reliability problem for an overall system. Particular reliability techniques available are indicated. The concepts developed are exemplified for a weather satellite system with automatic picture transmission. Author (ESA)

**N76-16896#** Cornell Univ., Ithaca, N.Y. Dept. of Operations Research.
**A MINIMAX TWO-STAGE PERMANENT ELIMINATION TYPE PROCEDURE FOR SELECTING THE SMALLEST NORMAL VARIANCES**
Ajit C. Tamhane Jun. 1975 33 p refs
(Contracts DAHC04-73-C-0008; N00014-67-A-0077-0020)
(AD-A014120; TR-260) Avail: NTIS CSCL 12/2

The problem of selecting the normal population associated with the smallest variance is considered. The indifference-zone approach is adopted and a two-stage permanent elimination type procedure is proposed. Expressions for the probability of correct selection and the expected total sample size associated with this procedure are derived. A complete proof of the least favorable configuration for the exact procedure could not be obtained for $k = 2$. Therefore a conservative procedure based on a lower bound on the probability of correct selection expression for the exact procedure is proposed. The minimax criterion is suggested for finding the design constants necessary to implement the above procedures. For the large sample case, the use of tables of the constants constructed for the corresponding procedures for the normal means problem is illustrated. Author (GRA)

**N76-16897#** National Bureau of Standards, Washington, D.C. Applied Mathematics Div.
**POST OPTIMALITY AND PARAMETRIC ANALYSIS WITH THE NATIONAL BUREAU OF STANDARDS LINEAR PROGRAMMING SUBROUTINE Final Report**
Tyrone B. Ayers Feb. 1975 48 p refs
(COM-75-11381/1; NRSIR-75-666) Avail: NTIS HC $4.00 CSCL 12B

The present report presents subroutines which perform postoptimality analysis and parametric programming studies on linear programming problems solved by the RVSMPX subroutine. The present versions of these codes use internal storage only. GRA

**N76-16898#** National Bureau of Standards, Washington, D.C. Applied Mathematics Div.
**THE NATIONAL BUREAU OF STANDARDS' LINEAR AND QUADRATIC PROGRAMMING SUBROUTINES Final Report**
W. G. Hall, R. H. F. Jackson, and P. B. Saunders Feb. 1972 70 p refs
(COM-75-11380/3; NBS-10695) Avail: NTIS HC $4.50 CSCL 12B

This report documents one phase of an effort to provide reliable, well-tested, clearly-described solution algorithms for selected frequently-arising classes of special mathematical problems. Algorithms for the simplex and revised simplex methods of linear programming are presented as well as their adaptations to quadratic programming. Set up as subroutines, the present versions of these codes use internal storage only, with resultant limitations on the size of the problems which can be treated. GRA

# 67 THEORETICAL MATHEMATICS

Includes topology and number theory.

**N76-16899** Carnegie-Mellon Univ., Pittsburgh, Pa.
**SOME FUNDAMENTAL RESULTS IN NON-STANDARD TOPOLOGY Ph.D. Thesis**
Robert Warren Button 1975 94 p
Avail: Univ. Microfilms Order No. 75-19847

A cohesive body of results about covering conditions, separation axioms, refinement conditions and product theorems, are presented, along with complementary results in model theory, Wattenburg's total monad systems, and especially Robinson's Q-topology. Results are presented and discussed. Dissert. Abstr.

# 70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

**N76-16900** Virginia Univ., Charlottesville.
**PERTURBATION FORMULATIONS FOR THE MOTION OF AN ARBITRARILY TORQUED ASYMMETRIC RIGID BODY Ph.D. Thesis**
Luther Glenn Kraige 1974 155 p
Avail: Univ. Microfilms Order No. 75-22821

Three analytical developments are presented. The first is an Encke-type perturbation formulation in which differential equations for the angular velocity and orientation departures from Poinsot motion are derived. The second technique is a variation of parameters scheme in which an analogue of Herrick's two-body perturbative differentiation method is employed. The torque-free motion constants selected for variation are initial orientation and initial angular velocity; differential equations which specify the time variation of these seven parameters were developed, so that the torque-free solution is instantaneously valid in the presence of arbitrary torques. The third technique is the method of successive approximations, which is shown to be equivalent to the universal time series solution for the torque-free case and is proved to be applicable to the arbitrary torqued case as well. Dissert. Abstr.

# 71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

**N76-16901#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**ESTIMATION IN ARMA MODEL WITH CORRELATED MEASUREMENT NOISE**

Rajat Kumar Saha [1975] 30 p refs
(INPE-638-RI/298) Avail: NTIS HC $4.00

An optimal linear filter for discrete systems with correlated noise measurement by the innovations method was introduced. The signal is assumed to be described by multivariate Autoregressive-Moving Average (APMA) model and the observation noise is assumed to be correlated and described by finite order moving average process. The new algorithm presented here avoids the increased order and other complexities of previously proposed methods, particularly those based on augmanted state and measurement differencing approaches. Computational aspects of this algorithm are also discussed. Author

**N76-16902#** Army Electronics Command, Fort Monmouth, N.J.
**COMPARISON OF A PASSIVE AND ACTIVE NOTCH FILTER FOR NOISE REDUCTION IN AIRBORNE COMMUNICATIONS**
John L. Politis Sep. 1975 36 p
(DA Proj. 1F2-63207-DB-97)
(AD-A015016; ECOM-4350) Avail: NTIS CSCL 17/2

The high noise environment present in a military helicopter creates two undesirable effects: (1) aviator hearing loss, and (2) reduced intelligibility. The noise environment studied in this report is the one which the pilot and copilot experienced on board the CH-47 (CHINOOK) helicopter. A detailed analysis of this noise reveals that it consists of several high-amplitude peaks within the audio frequency range. One approach to eliminating these peaks, and thus reducing the amount of noise reaching the aviators ears, is through the use of an electrical filter installed in the aircraft communications system. The 'ideal' filter for this purpose would be one that attenuates those frequencies at which peaks exist, and at the same time conserves as much of the audio frequency spectrum as possible. This latter requirement is necessary for good intelligibility of the overall communications system. The report gives a comparison of two different electrical filters. One is a passive device and is presently in use in each CH-47 in the Army's inventory. The other is a new state-of-the-art active traveling notch filter. The potential application of the active filter is discussed. GRA

**N76-16903#** Admiralty Underwater Weapons Establishment, Portland (England).
**THE ABSORPTION COEFFICIENT OF SOUND IN SEA WATER (KILOHERTZ RANGE)**
J. N. Elder Nov. 1974 44 p refs
(AD-A015135; AUWE-TN-516/74; DRIC-BR48574) Avail: NTIS CSCL 20/1

The report provides, in a form convenient for use as a ready reckoner on trials ships, a family of graphs of the one way transmission loss of sound in sea water under isovelocity conditions for the range of temperature 0C to 25C in steps of 5 and salinity values of 30, 33 and 36 ppt. Frequencies of 4 to 100 kHz are plotted. Tables of results up to 1000 kHz are provided. GRA

**N76-16904#** Texas Univ., Austin. Applied Research Labs.
**BASIC RESEARCH IN NONLINEAR ACOUSTICS Final Technical Report, 1 Apr. 1974 - 31 Mar. 1975**
David T. Blackstock 4 Sep. 1975 21 p refs Sponsored in part by AFOSR and NOAA
(Contracts N00014-70-A-0166; N00024-72-C-1380; NR Proj. 384-371)
(AD-A015296; ARL-TR-75-36) Avail: NTIS CSCL 20/1

Basic research in nonlinear acoustics was carried out during the 12-month period ending 31 Mar. 1975. Work on the following three projects is summarized: (1) Propagation of finite-amplitude waves in inhomogeneous (stratified) media (including vertical propagation in the ocean and the atmosphere; dependence of B/A for sea water on pressure, salinity, and temperature; and ray theory for finite-amplitude waves). (2) Modulation of sound by sound. (3) Development of a schlierene system to visualize intense sound fields. In addition, some earlier work on the parametric array in air was revised and published. GRA

# 72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

**N76-16905#** California Univ., Berkeley. Dept. of Chemistry.
**ZEEMAN EFFECT ON THE PMDR SIGNAL AND THE MECHANISM OF THE INTERSYSTEM CROSSING PROCESS IN PYRAZINE AT 1.6K**
Paul E. Zinsli and M. A. El-Sayed 29 Aug. 1975 19 p refs
(Contract N00014-75-C-0602; NR Proj. 056-498)
(AD-A014905; TR-23) Avail: NTIS CSCL 07/4

The observed change in the 10.38 GHz PMDR signal of pyrazine in durene at 1.6K upon the application of a magnetic field of 0-500 Gauss cannot be explained by the direct S sub 1(n,pi*) to T sub 1(n,pi*) intersystem crossing process. The observed results can be computer fitted if the crossing is assumed to involve an intermediate triplet state with zero-field parameters similar to those of the lowest pi,pi* state of substituted benzene. The relative probability of the direct to the indirect crossing to the different spin levels is concluded. The limitations of the method are discussed. GRA

# 73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

**N76-16906#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**ELECTRON SCATTERING AND NUCLEAR INTERACTIONS**
C. CiofiDegliAtti 14 Apr. 1975 20 p refs
(ISS-P-75/6) Avail: NTIS HC $3.50

The possibility of obtaining information on nuclear interactions by means of high energy electron scattering is discussed. It is shown that there exist several difficulties in reconciling experimental data and theoretical models based on static realistic two-body forces and Brueckner Hartree Fock approximations. Some effects of exchange currents are discussed. Also discussed is the Schroedinger equation. Author

**N76-16907#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**CP VIOLATION IN PURELY LEFTHANDED WEAK INTERACTIONS**
L. Maiani 10 Oct. 1975 12 p refs
(ISS-P-75/10) Avail: NTIS HC $3.50

In a model with six quarks and pure V-A weak interactions CP violation can be introduced in weak currents by spontaneous breaking. The resulting milliweak model is shown to lead uniquely, with good approximation, to the results of the superweak theory both for K decays and for the neutron electric dipole moment. Author

**N76-16908*#** Old Dominion Univ. Research Foundation, Norfolk, Va.
**A STUDY OF HEAVY-HEAVY NUCLEAR REACTIONS Progress Report, 1 Jul. - 31 Dec. 1975**
Govind S. Khandelwal (Old Dominion Univ.) 26 Jan. 1976 17 p refs
(Grant NGR-47-003-078)
(NASA-CR-146226) Avail: NTIS HC $3.50 CSCL 20H

A simplified theory for heavy ion scattering shows good agreement with heavy ion absorption experiments. Theoretical implications on the complete coupled channel reaction equations are discussed. Author

**N76-16909#** Argonne National Lab., Ill.
**PHYSICS OF REACTOR SAFETY Quarterly Report, Jan. - Mar. 1975**
1975 33 p refs

(Contract W-31-109-eng-38)
(ANL-75-31) Avail: NTIS HC $4.00

Progress in reactor safety research and technical coordination of the RSR safety analysis program is reported. Pump coastdown calculations were carried out for an improved model of the CRBR, with results similar to previous ones. A mild initial disassembly was obtained, but there is a remote possibility of a more severe one from failure of low-power pins in the presence of sodium. The PLUTO code was applied to this problem. Pump coastdown calculations were carried out for a model of 4000 MW(e) oxide-fueled LMFBR similar to one studied by P. Bleiweis et al. Pump rates from sodium voiding are only $10-20/sec instead of up to $250/sec reported by Bleiweis. Physics calculations were carried out for the equilibrium fuel cycle for the CRBR. A model of a boiling pool of liquid fuel and steel was developed and embodied in the POOL code; neutronics are furnished by the FX-2 space-time kinetics code. The status of nuclear data relevant to safety calculations is reviewed. A preliminary experimental program plan for core meltdown simulation experiments on ZPR's is presented. Author (NSA)

**N76-16910#** Battelle Pacific Northwest Labs., Richland, Wash.
**MODELS FOR PREDICTING THE REMOVAL OF AIRBORNE CONTAMINANTS BY REACTOR CONTAINMENT SPRAYS**
A. K. Postma, R. L. Ritzman, J. A. Gieseke, and E. W. Schmidt
27 Jun. 1975 122 p refs
(Contract AT(45-1)-1830)
(BNWL-B-417) Avail: NTIS HC $5.50

Mathematical models for spray removal of methyl iodide and aerosol particles, as well as a model for deposition of elemental iodine on wall surfaces were deduced from available experimental and theoretical information. The models were chosen to yield conservative estimates of fission product removal under postulated accident conditions in water reactors. Wall deposition of elemental iodine is limited by gas phase mass transfer resistance, and the rate of deposition may be predicted using a mass transfer model which describes transport through a thermally convected boundary layer. The wall deposition rate is small compared to spray washout and is important primarily because it permits total washout to be computed as a sum of wall sorption and spray washout. Methyl iodide absorption is a case of absorption with simultaneous chemical reaction, and may be predicted from models based on stagnant drops and wall films. Particle removal was predicted using the HAA-3B, modified to account for spray washout. Author (NSA)

**N76-16911#** Brookhaven National Lab., Upton, N.Y.
**PHYSICAL PRINCIPLES OF THERMOLUMINESCENCE AND RECENT DEVELOPMENTS IN ITS MEASUREMENT**
P. W. Levy 1974 18 p refs Presented at the Intern. Seminar on Appl. of Sci. to Dating of Works of Art, Boston, 23-25 Sep. 1974 Sponsored by ERDA
(BNL-20210; Conf-7409128-1) Avail: NTIS HC $3.50

The physical principles which are the basis of thermoluminescence techniques for dating and authenticating archaeological and fine art objects are described in nontechnical terms. Included is a discussion of the interaction of alpha particles, beta rays (energetic electrons), and gamma rays with solids, particularly electron-hole ion pair formation, and the trapping of charges by crystal imperfections. Also described is the charge-release process induced by heating and the accompanying emission of luminescence resulting from charge recombination and retrapping. The basic procedure for dating and/or authenticating an artifact is described. Recently developed apparatus is described for simultaneously measuring luminescent light intensity and wavelength and sample temperature. Examples of studies made with this 3-D apparatus are given and applications to dating and authenticating are described. Author (NSA)

**N76-16912#** Interuniversitair Reactor Instituut, Delft (Netherlands).
**A WAY OF TESTING THE REPEATABILITY OF NEUTRON DIFFRACTION RUNS**
J. B. VanTricht Oct. 1974 13 p refs
(IRI-132-74-05) Avail: NTIS HC $3.50

A system of statistical inferences for neutron diffraction data collection is introduced permitting the judgement of repeated series of measurements. The average of a number of series is obtained and the residuals are related to the expected scattering of data. The run test is used for evaluation, the number of positive and negative deviations from the average is obtained for each series, and the number of runs determined and tested against the population mean and standard deviation. The program in ALGOL is listed with a flow diagram together with an example of output. Author (ESA)

**N76-16913#** Brown, Boveri und Cie, A.G., Mannheim (West Germany).
**GAMMA RADIATION AND GAMMA PROTECTION FACTORS ONBOARD SHIPS DURING RADIOACTIVE FALLOUT [GAMMASTRAHLUNG UND GAMMASCHUTZFAKTOREN AN BORD VON SCHIFFEN BEI RADIOAKTIVEM NIEDERSCHLAG (FALL-OUT)]**
E. H. Brehm and T. Holst Bonn DOKZENTBw 1975 70 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(BMVG-FBWT-75-1) Avail: NTIS HC $4.50; DOKZENTBw DM 30

Methods of evaluating Gamma Ray Protection Factors (GRPF) for ships in various situations of radioactive fallout are discussed. These factors determine, in connection with a measured gamma radiation dose at a given detector point, the gamma radiation in different compartments of the ship. A computer program GASUFA was developed to calculate the GRPF. GASUFA performs calculations, considering energy, place, and time dependence, for the following situations: the ship under a radioactive cloud, with or without fallout; the ship contaminated by fallout; the clean or decontaminated ship going to a contaminated zone; and the ship and the surrounding water surface contaminated by fallout. ESA

**N76-16914#** Rensselaer Polytechnic Inst., Troy, N.Y.
**STUDIES OF NUCLEAR STRUCTURE Final Report, 1 Mar. 1968 - 30 Sep. 1973**
Jul. 1975 6 p refs
(Contract N00014-68-C-0384; NR Proj. 024-217)
(AD-A014668) Avail: NTIS CSCL 20/8

Pig lead was used for shielding in research projects in the area of nuclear physics. A list is presented of these and technical papers resulting from the experiments. M.J.S.

# 74 OPTICS

Includes light phenomena.

**N76-16915** Southern Methodist Univ., Dallas, Tex.
**NONLINEAR FILTERING AND BOUNDARY DETECTION FOR TWO-DIMENSIONAL IMAGES Ph.D. Thesis**
Panos Paul Varoutas 1975 203 p
Avail: Univ. Microfilms Order No. 76-848

Several nonlinear filtering methods were developed for two-dimensional signals. The first of these methods was termed pruning and is implemented in the frequency domain. Certain components of the two-dimensional amplitude spectrum, due to noise, are selectively set equal to zero, while keeping the phase spectrum constant. An inverse image transform generates the filtered result. The second method, called E-filters, utilizes a nonlinear transformation of the spatial coordinates which is proportional to the two-dimensional signal amplitude. The E-filters were implemented mainly by two different computational schemes. One starts the transformation of the spatial coordinators from the image corner and the other starts from the image center. The latter scheme seems to present less distortion than the former for images that are approximately symmetric about their center. The nonlinear filtering techniques were applied to phantom images as well as brain and heart scan images obtained by an Anger scintillation camera. Dissert. Abstr.

**N76-16916*#** Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
**SOLID STATE ELECTRO-OPTIC COLOR FILTER AND IRIS Interim Report, Apr. - Nov. 1974**
18 Dec. 1974 56 p ref
(Contract NAS9-13549)

(NASA-CR-147408; AED-R-4064) Avail: NTIS HC $4.50 CSCL 20F

The electro-optic properties of lanthanum-modified lead zirconate titanate (PLZT) ferroelectric ceramic material are evaluated when utilized as a variable density and/or spectral filter in conjunction with a television scanning system. Emphasis was placed on the development of techniques and procedures for processing the PLZT disks and for applying efficient electrode structures. A number of samples were processed using different combinations of cleaning, electrode material, and deposition process. Best overall performance resulted from the direct evaporation of gold over chrome electrodes. A ruggedized mounting holder assembly was designed, fabricated, and tested. The assembly provides electrical contacts, high voltage protection, and support for the fragile PLZT disk, and permits mounting and optical alignment of the associated polarizers. Operational measurements of a PLZT sample mounted in the holder assembly were performed in conjunction with a television camera and the associated drive circuits. The data verified achievement of the elimination of the observed white-line effect. Author

**N76-16917*#** Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.

**SOLID STATE ELECTRO-OPTIC COLOR FILTER AND IRIS Interim Report, Jul. 1973 - Mar. 1974**

31 May 1974 180 p refs Original contains color illustrations (Contract NAS9-13549)

(NASA-CR-147409; AED-R-4013F) Avail: NTIS HC $7.50 CSCL 20F

Test results obtained have confirmed the practicality of the solid state electro-optic filters as an optical control element in a television system. Neutral-density control range in excess of 1000:1 has been obtained on sample filters. Test results, measurements in a complete camera system, discussions of problem areas, analytical comparisons, and recommendations for future investigations are included. Author

**N76-16918*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**X-RAY REFLECTION AND SCATTER MEASUREMENTS ON SELECTED OPTICAL SAMPLES**

Stanley A. Fields, John M. Reynolds, and Robert L. Holland Nov. 1975 77 p refs

(NASA-TM-X-64974) Avail: NTIS HC $5.00 CSCL 20F

The results from an experimental program to determine the reflection efficiency and scatter parameters of selected optical samples are presented. The measurements were made using 8.34A X-rays at various angles of incidence. Selected samples were contaminated after being measured and then remeasured to determine the effects of contamination. The instrumentation involved in taking the data, including the X-ray reflectometer and data processing equipment, is discussed in detail. The condition of the optical surfaces, the total reflection measurements, the scatter measurements, and the analysis are discussed. Author

**N76-16919*#** Scientific Translation Service, Santa Barbara, Calif.

**INVASION OF PRIVACY WITH OPTICAL AND ELECTRO-OPTICAL MEANS**

Patrik Wahren Washington NASA Jan. 1976 21 p Transl. into ENGLISH from Swedish Report FOA-2 (Stockholm), Sep. 1968 16 p

(Contract NASw-2791)

(NASA-TT-F-16862) Avail: NTIS HC $3.50 CSCL 20F

The most important methods for invasion of privacy with optical and electro-optical means are explained. The price of the parts, availability, and other uses are also reported. The expected technical developments are indicated in certain cases. Author

**N76-16920#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**THE ELECTROMAGNETIC THEORY OF THREE-DIMENSIONAL INHOMOGENEOUS LENSES**

Pawel Rozenfeld Feb. 1975 53 p refs

(INPE-637-RI/297) Avail: NTIS HC $4.50

The characteristics of some inhomogeneous lenses were investigated. The lenses covered were the Luneburg, the Eaton-Lippmann and the Eaton. The expression for the electric field of a Huygens source in the presence of an inhomogeneous lens was constructed. The electric field scattered by the lenses was found. Radiation patterns and the bistatic scattering cross-sections for the small-diameter lenses as well as the directivity and the distribution of the energy around the geometrical focus of the Luneburg lenses were numerically computed and examined in detail. Author

**N76-16921#** Naval Training Equipment Center, Orlando, Fla.

**TECHNOLOGICAL PROJECTION FOR LASER DEFLECTORS Final Report, Jan. - May 1972**

George Derderian, Albert H. Marshall, Alfred H. Rodemann, Denis R. Breglia, and Windell Neil Mohon Jul. 1975 25 p refs

(NAVTRAEQUIPCEN Proj. 1710)

(AD-A014208; NAVTRAEQUIPC-TN-33) Avail: NTIS CSCL 20/6

A concise description is given of the state-of-the art of laser deflectors. Types of deflectors discussed include mechanical-electromechanical mirror, acousto-optic, electro-optic, internal reflection, and fiber-optic scanners. Basic equations and data are given for most types. A projection is given for the state of the art in 1980. Several related topics and operational implications are also mentioned. GRA

**N76-16922#** Raytheon Co., Waltham, Mass. Research Div.

**CHEMICAL VAPOR DEPOSITION OF MULTISPECTRAL DOMES Final Report, 19 Mar. 1973 - 19 Sep. 1974**

B. A. DiBenedetto and J. Pappis Apr. 1975 96 p refs

(Contract F33615-73-C-1073)

(AD-A014362; S-1792; AFML-TR-75-27) Avail: NTIS CSCL 20/6

The program demonstrated the capability of fabricating chemical vapor deposited zinc sulfide windows and hemispherical domes. A zinc sulfide plate, 10 X 10 X 5/8 in., and a 9-inch hemispherical dome were fabricated and optically polished to specification. As a result of this work the optical and structural properties of zinc sulfide were significantly improved. For example, a 60 percent increase in strength was realized. It was also demonstrated that it is possible using the CVD process to deposit multiple domes per run. With further development a significant cost savings for this type of hardware should be realized. Significant progress was also made in the development of zinc sulfo-selenide solid solutions. Improvements were realized in the optical and structural properties of these deposits. At the conclusion of the program a clearer understanding of the cause of scatter in these materials and zinc sulfide had been attained that resulted in improved materials. GRA

**N76-16923#** Uppsala Univ. (Sweden). Geodetic Inst.

**DETERMINATION OF ANGULAR REFRACTION WITH THE MULTI WAVELENGTH METHOD Final Report, 1 Jul. 1968 - 30 Apr. 1975**

Erik Tengstrom and Stig Martensson 30 Apr. 1975 51 p refs

(Contract F61052-68-C-0075)

(AD-A015074; AFCRL-TR-75-0383) Avail: NTIS CSCL 20/6

The report contains the present results of refraction experiments with Interferodispersometer instruments, using the Dual Wavelength method. It is shown, that refraction can be determined in the field up to at least 20 km. Results of measurements with IDM 1 have been compared to simultaneous vertical angle measurements. The changes of these versus time agree to within 1 inch with the IDM-results. For IDM 2 no results are yet available from the field observations. The absolute comparison gives the same order of magnitude for IDM 1. (I,II - IV(prel.) The possibility of making absolute comparison rests on the fact, that the refraction-angle at the observer's site can be computed from ellipsoidal, geoidal and levelling data, using vertical angle measurements. GRA

**N76-16924#** Raytheon Co., Waltham, Mass. Research Div.

**CASTING OF HALIDE AND FLUORIDE ALLOYS FOR LASER WINDOWS Semiannual Technical Report**

R. T. Newberg and J. Pappis 15 Apr. 1975 67 p refs

(Contract F19628-74-C-0148; ARPA Order 2669)

(AD-A014864; S-1864; AFCRL-TR-75-0289; SATR-2) Avail: NTIS CSCL 20/6

The main objective of this program is to demonstrate the feasibility of fusion casting of alkali halides and alkaline earth fluorides for high power laser window applications. The main effort deals with the fabrication and property evaluation of the alkaline earth fluorides. During the second six months of this program high quality castings of both CaF2 and SrF2 were fabricated. Castings of CaF2 were attempted in an inert atmosphere of purified argon (1-50 torr). Calorimetrically measured 5.25 micrometer bulk absorption coefficients for cast CaF2 are being consistently attained near 0.00042/cm regardless of the starting material. In preliminary results the 5.25 micrometer bulk absorption coefficient of cast SrF2 lies near 0.000067/cm for an ingot using single crystal chips as starting material and lies near 0.00017/cm for an ingot cast from purified 'reagent' grade powder. The preliminary results also show that SrF2 is equivalent in strength to CaF2 and that polycrystalline cast material is equivalent in strength to single crystal material. GRA

**N76-16925#** Ohio State Univ. Research Foundation, Columbus.
**RESEARCH EFFORT IN ATMOSPHERIC PROPAGATION Final Technical Report, 1 Dec. 1974 - 30 May 1975**
S. A. Collins, Jr., D. D. Duncan, and Y. J. Liu Aug. 1975 51 p refs
(Contract F30602-75-C-0149; AF Proj. 3326)
(AD-A014826; OSURF-4097-1; RADC-TR-75-200) Avail: NTIS CSCL 20/6

This report presents work performed on: (1) The propagation of light through aircraft boundary layers; (2) The measurement and interpretation of refractive index spectra at high altitudes; and (3) The temporal spectra of angle-of-arrival fluctuations. A method of analyzing the data from the experiment on light beams propagating through aircraft boundary layers to obtain the boundary layer MTF was presented. Next a calculation of the effects of velocity and air mean free path on wire microthermal measurements was reported. The results were that the procedure of calibrating a microthermal sensor at zero velocity and making measurements at low altitude at Mach 1 can have up to 17% error. Further, flying at an altitude of 20 km where the air molecular mean free path is larger can increase the error another 4%. A discussion of refractive index spectra obtained from airborne microthermal measurements resulted in an empirical formula which could be made to fit the data. The formula involved the addition of two von Karman type of spatial spectra. The data showed outer scales between 300 to 1000 meters. Finally, results of an analysis on the temporal spectrum of angle-of-arrival fluctuations were presented. The model included a moving source, and a position proportional detector. The resulting curve showed a peak contribution from refractive index fluctuations of size equal to one fifth the source height. GRA

**N76-16926#** Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
**RESEARCH IN MATERIALS SCIENCE Final Technical Report, 1 Jun. 1973 - 31 May, 1975**
D. J. Epstein, R. M. Rose, M. MacVicar, and R. Lagow 31 May 1975 220 p refs
(Contract DAHC15-73-C-0316; ARPA Order 2469)
(AD-A014996) Avail: NTIS CSCL 20/6

Contents: Minilaser development - material design, ER(3+) sensitized Ho(3+) lasers, Yb(3+) sensitized Ho(3+) lasers, LED pumping considerations; Diode pumps - diode pumps program objectives and structure, diode fabrication and evaluation, silicon doped gallium arsenide, gallium arsenide antimonide; KTN (KTa(1-x)Nb(x)O3) thin films - growth of single crystal films, film characterization, device fabrication and evaluation, growth of KTN by chemical vapor deposition; Laser output coupling - Synchronous coupling; Grating facility; Preparation of feed materials for crystal growth - clean room, chemical techniques, chemicals and reagents: sources and purification, chemicals: sources of material to be processed into crystal growth feed, synthesis of crystal growth feed materials, fluoride crystal growth; Publications and talks. GRA

**N76-16927#** Texas Instruments, Inc., Dallas. Equipment Group.
**DEVELOPMENT OF GALLIUM ARSENIDE FOR INFRARED WINDOWS Final Report, 21 Jan. 1974 - 21 Feb. 1975**
Harold C. Hafner and George R. Cronin May 1975 71 p refs
(Contract F33615-74-C-1066; AF Proj. 7371)
(AD-A014809; TI-U1-862001-F; AFML-TR-75-49) Avail: NTIS CSCL 20/6

This report describes methods for preparing high quality infrared transmitting gallium arsenide. The work is broadly divided into categories describing doping studies, vertical pulling techniques, liquid encapsulation, growth methods, horizontal Bridgman and gradient freeze techniques, boat materials, and measurement results. In addition to infrared transmission curves, data are also presented which describe other physical parameters such as Knoop hardness and refractive index. A complete fabricating process is described which has routinely produced gallium arsenide infrared transmitting windows measuring 4 by 6 by 0.5 inches and exhibiting good transmission characteristics over the range of wavelength between 2 and 12 micrometers. The process is a horizontal synthesis technique in which high purity gallium, arsenic, and suitable dopants such as chromium and oxygen are compounded in a flat-bottom fused-silica boat. These are slowly cooled so that a directional freeze occurs at a predetermined rate. Annealing at elevated temperatures and slow cooling are a part of this process. GRA

**N76-16928#** University of Southern Calif., Los Angeles. Electronic Sciences Lab.
**IR WINDOW STUDIES Semiannual Technical Report**
Ferdinand A. Kroger and John H. Marburger 15 Mar. 1975 104 p refs
(Contract F19628-75-C-0080; AF Proj. 2055)
(AD-A014867; AFCRL-TR-75-0236; SATR-1) Avail: NTIS CSCL 20/6

Crystals of CdTe doped with P, Al, Al-Sb and others were grown. Local mode absorption was measured for these crystals and for CdTe-Al-Cu, Ag, Au. Indium precipitates from CdTe if cooled under high pressure of cadmium. The defect structure of CVD ZnSe was determined by electron microscopy, electron microprobe, cathodoluminescence scanning microscope: precipitates of Se, dislocations, twins and stacking faults are observed. NaCl exposed to active oxygen develops a surface layer with characteristic absorption believed to be due to ClO3. Further support is found for the attribution of the residual infrared absorption in KBr to BrOx ion. Thermal lensing was studied experimentally to give dn/dt. For CdTe dn/dt - 0 was found. Theoretical considerations for the effects of residual T-independent birefringence (homogeneous or inhomogeneous), grain boundaries, stresses and strains on thermal lensing are given. An analysis is given for the refractive index of ZnSe and LiF, and apparatus for the accurate measurement of dn/dt is set up. GRA

**N76-16929#** National Bureau of Standards, Washington, D.C. Optical Physics Div.
**OPTICAL MATERIALS CHARACTERIZATION Semiannual Technical Report, 1 Jan. - 31 Jul. 1975**
Albert Feldman, Deane Horowitz, Roy M. Wayler, Irving H. Malitson, and Marilyn J. Dodge Aug. 1975 25 p refs
(ARPA Order 2620)
(COM-75-11375/3; NBSIR-75-781) Avail: NTIS HC $3.50 CSCL 20F

The refractive index of each of two prismatic samples of chemical vapor deposited (CVD) ZnSe was measured from 0.5086 micrometer to 18.2 micrometers by means of the minimum-deviation method on a precision spectrometer. Data were obtained at temperatures near 20 C and 34 C, and each set of data was fitted to a three-term Sellmeier-type dispersion equation, which permits refractive index interpolation within several parts in 10 to the -5th power. From the data obtained at the two temperatures, dn/dT was calculated for both samples. A comparison of refractive index and dn/dT is made with other types of ZnSe. Preliminary photoelastic data are presented for single crystal specimens of Ge, reactive atmosphere processed KCl, and KCl doped with KL. Also presented are revised photoelasticity data for CVD ZnSe. The design of an improved stressing apparatus that was developed for the measurement of photoelastic constants is discussed. GRA

# 75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**N76-16930** Saskatchewan Univ., Saskatoon.
**PLASMA BEHAVIOUR IN A ROTATING MAGNETIC FIELD Ph.D. Thesis**
Murray Robert Shubaly 1974 144 p
Avail: Univ. Microfilms Order No. 76-742

A system was constructed and used to study the behavior of a plasma in a rotating magnetic field in a toroidal system. The plasma density is first formed by RF pre-ionization at low pressure in the presence of a quasi-steady toroidal magnetic field of 0.4 T. The 1.85 MHz rotating magnetic field is generated by two perpendicular four-turn coils driven in phase quadrature by an amplifier and a variable coupler. Maximum rotating field strength in the presence of a plasma is 1.3 mT. Plasma electron density and temperature are measured with Langmuir probes. Pickup loops are used to determine plasma currents by measuring the magnetic field that they generate. The behavior of the plasma can be considered in two regimes. For the rotating field amplitude less than 0.8 mT the plasma forms a single-peaked density distribution displaced towards the outer wall of the chamber. Plasma compression is indicated by the fact that the density at the walls is very much less than during the RF pre-ionization phase. Dissert. Abstr.

**N76-16931*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**HOT ION PLASMA PRODUCTION IN HIP-1 USING WATER-COOLED HOLLOW CATHODES**
J. J. Reinmann, M. R. Lauver, R. W. Patch, R. W. Layman, and A. Snyder 14 Nov. 1975 57 p refs Presented at Seventh Ann. Meeting of Div. of Plasma Physics of Am. Phys. Soc., St. Petersburg, Fla., 10-14 Nov. 1975
(NASA-TM-X-71852) Avail: NTIS HC $4.50 CSCL 20I

A steady-state ExB plasma was formed by applying a strong radially inward dc electric field near the mirror throats. Most of the results were for hydrogen, but deuterium and helium plasmas were also studied. Three water-cooled hollow cathodes were operated in the hot-ion plasma mode with the following results: (1) thermally emitting cathodes were not required to achieve the hot-ion mode; (2) steady-state operation (several minutes) was attained; (3) input powers greater than 40 kW were achieved; (4) cathode outside diameters were increased from 1.2 cm (uncooled) to 4.4 cm (water-cooled); (5) steady-state hydrogen plasma with ion temperatures from 185 to 770 eV and electron temperatures from 5 to 21 eV were produced. Scaling relations were empirically obtained for discharge current, ion temperature, electron temperature, and relative ion density as a function of hydrogen gas feed rate, magnetic field, and cathode voltage. Neutrons were produced from deuterium plasma, but it was not established whether thay came from the plasma volume or from the electrode surfaces. Author

**N76-16932#** California Univ., Berkeley. Lawrence Berkeley Lab.
**INTERFEROMETRIC RECONSTRUCTION OF ELECTRON NUMBER DENSITIES IN LASER-INDUCED PLASMAS**
D. W. Sweeney, D. T. Attwood, and L. W. Coleman 4 Aug. 1975 8 p refs Presented at the Topical Meeting on Image Processing for 2-D and 3-D Reconstruction from Projections; Theory and Practice in Med. and the Phys. Sci., Stanford, Calif. Sponsored by ERDA
(UCRL-76667; Conf-750801-3) Avail: NTIS HC $3.50

Holographic interferometry is used to reconstruct the electron number densities in a laser-induced plasma. The axisymmetric plasma field is reconstructed using a Fourier-Bessel series expansion technique. Author (NSA)

**N76-16933#** Columbia Univ., New York.
**INITIAL SHOCK HEATING IN A HIGH BETA BELT PINCH**
R. Taussig Jun. 1975 4 p refs Presented at the 7th Conf. on Numerical Simulation of Plasmas, New York, 2-4 Jun. 1975
(Contract AT(11-1)-2456)
(COO-2456-15; Conf-750606-5) Avail: NTIS HC $3.50

The first quarter cycle magnetic field compression of an elongated belt pinch is simulated with a one-dimensional one fluid, two-temperature (magnetohydrodynamic) code. The full anisotropic classical transport coefficients are used in order to predict accurately the ion and electron temperatures during initial shock heating of the plasma. The numerical scheme is a Lagrangian adaptation of the Hain-Roberts code with an additional iterative loop developed by Schneider to insure convergence when real transport properties are used. An external circuit equation which includes a time varying inductance for the plasma, is coupled to the MHD code. The results of these simulations provide realistic temperature and density profiles as input to equilibrium and stability analyses for the belt pinch. Author (NSA)

**N76-16934#** Los Alamos Scientific Lab., N.Mex.
**ENGINEERING CONCEPTS FOR LASER-FUSION REACTOR APPLICATIONS**
L. A. Booth, T. G. Frank, and F. T. Finch 1975 18 p refs Presented at the 10th Intersoc. Energy Conversion Eng. Conf., Newark, Del., 17-22 Aug. 1975
(Contract W-7405-eng-36)
(LA-UR-75-736; Conf-750812-2) Avail: NTIS HC $3.50

The long-range potential goal of the ERDA Laser Fusion Program is the production of commercial electric power. Although the scientific feasibility of significant thermonuclear energy release from laser imploded and heated pellets remains to be demonstrated, significant progress has been made toward this goal and many technological problems associated with ultimate applications of laser fusion are being investigated. Preliminary evaluations of several laser fusion reactor concepts have been made, and detailed studies of the most promising concepts, employing different methods for protecting structural components from damage by the products of fusion-pellet microexplosions, are being done. Engineering design and feasibility studies are also being done of other electric generating station subsystems. Overall economic and technology tradeoff studies are being done to assess the economic potential of various generating station concepts and to provide guidance for research and development programs. Author (NSA)

**N76-16935#** Oak Ridge National Lab., Tenn.
**RESEARCH PROGRAM FOR PLASMA CONFINEMENT AND HEATING IN ELMO BUMPY TORUS DEVICES**
R. A. Dandl, R. A. Dory, and H. O. Eason Jun. 1975 155 p refs
(Contract W-7405-eng-26)
(ORNL-TM-4941) Avail: NTIS HC $6.75

A sequence of experimental devices and related research activities which leads progressively toward an attractive full-scale reactor is described. The implementation of the steps in this sequence hinges on the development of microwave power sources, with high specific power levels, at millimeter wave-lengths. Two proposed steps in this sequence are described. The first step proposed here, denoted EBT-S, requires increasing the EBT magnetic field to permit microwave heating at 18 and 28 GHz as compared to the present 10.6 and 18-GHz configuration. In the second step a new, super-conducting bumpy torus, EBT-2, would be fabricated to permit microwave heating at 90 and 120 GHz. This device would be designed to produced plasma densities and temperatures comparable to those of present-day Tokamaks. The experimental and theoretical research on EBT that was carried out to date or formulated for the near future is reviewed. A status report as well as a research program plan is provided. Author (NSA)

**N76-16936#** Columbia Univ., New York.
**NUMERICAL SOLUTION OF THE MHD PLASMA EQUILIBRIUM EQUATION**
M. F. Reusch Jun. 1975 2 p refs Presented at the 7th Conf. on Numerical Simulation of Plasmas, New York, 2-4 Jun. 1975
(Contract AT(11-1)-2456)
(COO-2456-14; Conf-750606-4) Avail: NTIS HC $3.50

The solution of the plasma equilibrium equation was the subject of past interest both as a necessary prerequisite for the study of plasma stability, and in itself for the maximization of certain desirable equilibrium properties. Most previous work has

neglected an obvious consequence of the nonlinearity of the problem, namely bifurcation of the solutions. Bifurcation is the possibility of the existence of more than one or no solutions at all to the problem. A simple estimate of solution multiplicity and a method for obtaining them are given. Author (NSA)

**N76-16937#** Oak Ridge National Lab., Tenn.
**NONLINEAR EVOLUTION OF MHD INSTABILITIES**
G. Bateman, H. R. Hicks, J. W. Wooten, and R. A. Dory 1975 4 p refs Presented at the 7th European Conf. on Controlled Fusion and Plasma Phys., Lausanne, Switz., 1 Sep. 1975 Sponsored by ERDA
(CONF-750905-9) Avail: NTIS HC $3.50

A 3-D nonlinear MHD computer code was used to study the time evolution of internal instabilities. Velocity vortex cells are observed to persist into the nonlinear evolution. Pressure and density profiles convect around these cells for a weak localized instability, or convect into the wall for a strong instability. Author (NSA)

**N76-16938#** Rensselaer Polytechnic Inst., Troy, N.Y.
**DEVELOPMENT OF A BEAM PROBE DIAGNOSTIC SYSTEM FOR THE UNITED AIRCRAFT LITE PROGRAM Final Report, 1 Apr. 1974 - 31 Mar. 1975**
J. H. Stufflebeam, W. C. Jennings, K. A. Connor, and R. L. Hickok Jul. 1975 62 p refs
(Contract AT(11-1)-2444)
(COO-2444-2) Avail: NTIS HC $4.50

A heavy ion beam probe diagnostic system for the LITE plasma device was designed, fabricated, tested, and installed. The beam was aligned and slaved to the LITE magnetic field and the predicted defocusing of the beam was confirmed. A sophisticated beam trajectory programmer to control the operation of the beam probe system was developed and placed into operation. The electrostatic energy analyzer detector system was installed and preliminary noise measurements were made. The system is now ready for final testing under full plasma operating conditions. Author (NSA)

**N76-16939#** Toulouse Univ. (France).
**MECHANISM OF THE DISCHARGES ESTABLISHED IN DISPLAY PANELS WITH DIELECTRIC WALLS M.S. Thesis**
Kadri-Hassani Mohamed 1974 86 p refs In FRENCH; ENGLISH summary
(FRNC-TH-520) Avail: ERDA Depository Libraries HC $7.50

The transistory discharge which is built up in cells of plasma display panels was studied. A scheme for the external circuit-cell coupling is set up. With its help, it is possible to elaborate an experimental tool which gives one the electrical data characteristics of the discharge. A numerical simulation for a monodimensional scheme is made. Author (NSA)

**N76-16940#** Los Alamos Scientific Lab., N.Mex.
**LTPF: A LINEAR THETA-PINCH NEUTRON SOURCE**
W. R. Ellis Jul. 1975 44 p refs Sponsored by ERDA
(LA-6032-MS) Avail: NTIS HC $4.00

The linear theta pinch is optimized with respect to maximum neutron current on a sample located between the discharge tube and the compression coil wall. Emphasis is placed on physics and technology considerations which govern the choice of parameters. Point designs are developed which are distinguished by their compressional magnetic field (i.e., coil current) wave forms: one is sinusoidal and continuous, the other trapezoidal and pulsed intermittently. Both devices are characterized by short lengths (approximately 1 m), rapid cycling (2 to 3 kHz), and magnetic mirrors (2 to 5:1) at the ends. A crucial item is the power supply, which is discussed in detail. Author (NSA)

**N76-16941#** Oak Ridge National Lab., Tenn.
**INTERACTION OF NEUTRAL HYDROGEN AND PLASMA INCLUDING WALL REFLECTION**
J. F. Clarke and D. J. Sigmar 1975 4 p refs Presented at the 7th European Conf. on Controlled Fusion and Plasma Phys., Lausanne, Switz., 1 Sep. 1975 Sponsored by ERDA
(CONF-750905-6) Avail: NTIS HC $3.50

The kinetic equation for the neutral hydrogen in a hot plasma is solved by taking into account gas feed, Franck-Condon neutrals, wall absorption and re-emission of neutrals, electron impact ionization, and charge exchange reactions. Steady state neutral profiles are obtained showing the effect of neutral hydrogen on the ion momentum and energy balance. Author (NSA)

**N76-16942#** Princeton Univ., N.J. Plasma Physics Lab.
**SYSTEM FOR RAPID INJECTION OF METAL ATOMS INTO PLASMAS**
E. S. Marmar, J. L. Cecchi, and S. A. Cohen Jul. 1975 24 p refs Sponsored by ERDA
(MATT-1138) Avail: NTIS HC $3.50

A system for producing 300 mu s bursts of 10 to the 17th power metal atoms with 3 eV average energy is described. It is shown that this system can be successfully used to introduce impurities into CTR oriented tokamaks for transport and confinement studies. Author (NSA)

**N76-16943#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**HOLLOW CATHODE DISCHARGE: ARC REGIME WITH INTERIOR POSITIVE COLUMN IN ARGON FLOW Ph.D. Thesis - Paris Univ.**
Andre Brunet Jun. 1975 57 p refs In FRENCH; ENGLISH summary Report will also be announced as translation
(ONERA-NT-1975-3) Avail: NTIS HC $4.50

Plasma generated in the cathode is dealt with. The device used comprises a cathode and an anode with a central orifice through which the plasma is ejected. The anode is placed at the cathode outlet. The study of argon flow inside the cathode emphasized the presence of a sonic flow in the cathode outlet section. Assuming the gas temperature equal to that of the wall, the pressure distribution inside the cathode was determined. The plasma characteristics were measured with electrostatic probes; electron densities reached 10 to the 14th power electrons/cu m, electron temperatures were 1 to 2 eV, and plasma potentials were close to the anode potential, the major part of the discharge voltage being concentrated within the cathode sheath. The influence of the cathode material on the discharge characteristics was emphasized. The use of materials whose electronic emission is greater than that of refractory metals of current use permits one to lower the cathode temperature as well as the discharge voltage. With LaB6 cathodes it has been possible to operate the discharge with a total voltage lower than the argon ionization potential, which is explained by a two-step ionization process with a metastable level in-between. Author (ESA)

**N76-16944#** Naval Research Lab., Washington, D.C.
**MAGNETIC PROBE FOR USE IN INTENSE ELECTRON BEAM ENVIRONMENT**
Kent A. Gerber Aug. 1975 19 p refs
(NRL Proj. H02-28B; RR0110941)
(AD-A014399; NRL-MR-3093) Avail: NTIS CSCL 20/9

A description is given for a quartz housed, liquid dielectric filled, magnetic probe as it is employed on the NRL 'Triton' experiment. Plasma-housing and beam-housing interactions, including direct beam heating and resulting pressure effects as well as dielectric requirements, are discussed. GRA

**N76-16945#** TRW Systems Group, Redondo Beach, Calif.
**EXPERIMENTAL INVESTIGATION OF SINGLE AND COUNTERSTREAMING ION FLOWS IN THE PRESENCE OF MAGNETIC FIELDS Final Report**
J. M. Sellen, Jr. and G. K. Komatsu 18 Jun. 1975 149 p refs
(Contract DNA001-72-C-0096)
(AD-A014962; DNA-3665F) Avail: NTIS CSCL 20/9

Present ion flow experiments differ from previous measurements in three significant respects. These are: (1) The use of pairs of electron emissive probes for direct determinations of turbulent electric field magnitudes (as compared to the use of a single probe), (2) the examination of ion flow at non-normal incidence to the magnetic field (previous experiments utilized transverse magnetic fields), (3) the use of signal averaging techniques for measured densities and potentials for injected density wave motion across field lines (thus eliminating impact from turbulent electric fields). GRA

**N76-16946#** Naval Research Lab., Washington, D.C.
**STEADY-STATE THERMONUCLEAR POWER GENERATION IN A TWO-ENERGY-COMPONENT ASTRON DEVICE**
K. R. Chu and C. A. Kapetanakos Aug. 1975 18 p refs
(AD-A014860; NRL-MR-3103) Avail: NTIS CSCL 20/9

Energetic neutral beams and the two-energy-component reactor principle can be employed in Astron magnetic-field geometry to produce a steady-state fusion device with the following features: (1) lenient breakeven conditions (as in other types of two-component devices); (2) self-confinement of the energetic ions; and (3) closed minimum-B configuration for stable plasma confinement. GRA

**N76-16947#** Naval Research Lab., Washington, D.C.
**NUMERICAL STUDIES OF END LOSSES FROM A LINUS THETA PINCH**
Paulett C. Liewer Aug. 1975 41 p refs
(AD-A014857; NRL-MR-3092) Avail: NTIS CSCL 20/9

In the near future, a large fusion experiment will be performed at the Kurchatov Institute in Moscow by implosion of a cylindrical metallic linear surrounding a plasma and its confining magnetic field. In this scheme, a megagauss field is created by compressing an initial kilogauss field, the plasma is compressed to densities on the order of 10 to the 19th power/cc. The Lawson time for such dense plasmas is reduced to tens of microseconds. Since the system can be contained on this time scale by the inertia at the liner, breakeven can theoretically be achieved. An important limiting factor here, as in all straight theta pinches, is the amount of energy lost out the ends: the longer the theta pinch, the smaller the losses. The minimum length necessary for breakeven is determined by losses due to electron thermal conduction, plasma flow to the ends (convection) and Bremsstrahlung radiation. The losses can, in theory, be partially or totally compensated for by the heating caused by electron collisions with the 3.5 MeV alpha particle from the D-T reaction. The purpose of the work reported here is to study numerically the scaling of these losses with system size and other parameters when the losses are integrated over the compression cycle. GRA

**N76-16948#** Parker (Lee W.), Inc., Concord, Mass.
**COMPUTER METHOD FOR SATELLITE PLASMA SHEATH IN STEADY-STATE SPHERICAL SYMMETRY**
31 Jul. 1975 49 p refs
(Contract F19628-75-C-0182; AF Proj. 8600)
(AD-A015066; AFCRL-TR-75-0410) Avail: NTIS CSCL 20/9

The present report is concerned with a computational model for describing the interaction between an idealized spacecraft and a parameterized plasma. The spacecraft is represented by a conducting sphere, while the ambient plasma is stationary with respect to the sphere and consists of electrons and ions. The electrons and ions are assumed to be described by Maxwellian distributions, with temperature and number density as the parameters. The sphere is assumed to be non-emitting and to absorb all charges incident on it. (Photoelectron and secondary electron emission, which are important at high altitudes, can be included by an extension of the computer method of this report). This model is identical to that of a spherical electrostatic Langmuir probe, the theory of which at arbitrary Debye lengths has been treated by Laframboise. The electric field and the ion and electron density distributions are spherically symmetric about the sphere, and depend only on the radial distance. GRA

**N76-16949#** Naval Postgraduate School, Monterey, Calif.
**ELECTRODE LOSS MECHANISMS IN MHD GENERATORS Interim Report**
Oscar Biblarz and R. C. Dolson May 1975 36 p refs
(AF Proj. 9752)
(AD-A015393; NPS-57Z175052; AFOSR-75-1383TR) Avail: NTIS CSCL 10/2

The principal voltage loss mechanisms in the MHD generator can be divided into two classes, ohmic and sheath losses. Ohmic drops are those that occur because of the finite conductivity of a real plasma; thermal boundary layers, degree of ionization and Joule heating are factors affecting the Ohmic resistivity of the plasma. Sheath drops occur as a result of Debye shielding near the electrode surfaces and can be handled separately from the boundary layer. These phenomena were studied with emphasis on the sheath. It was concluded that these effects can be assigned to the boundary layers, and a simplified technique for determining boundary layer losses was developed. A two-dimensional model for the electrode region has evolved, incorporating the sheath and ambipolar regions. Current, electric field, and energy equations are being studied as they apply to the model. Results are presented. GRA

# 76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**N76-16950** Northwestern Univ., Evanston, Ill.
**THE ELECTRICAL PROPERTIES OF THIN, ORDERED PHOSPHOLIPID FILMS Ph.D. Thesis**
William Louis Procarione 1975 104 p
Avail: Univ. Microfilms Order No. 75-29730

The electrical properties of metal-insulator-metal (MIM) thin film junctions were investigated. The insulating layer of these junctions was composed of highly ordered, monomolecular layers of synthetic phosphatidylcholine deposited by the Langmuir-Blodgett process. This particular system was chosen for study for two reasons: first, because it was an experimentally tractable model for the ordered, lamellar phospholipid structures associated with electron or energy transport in the important biological processes of respiration, photosynthesis, and vision; secondly, to determine if this type of system had properties that might be useful in certain device applications. The important points of the sample fabrication process were described in some detail. The resulting MIM structure was illustrated and the potential effects of the oxidation of the metal electrodes was discussed. The capacitance, current-voltage, and conductance versus temperature and thickness characteristics of these junctions were studied in the -80 C to +1000 C temperature range.
Dissert. Abstr.

**N76-16951** Virginia Univ., Charlottesville.
**INTRAMOLECULAR INTERACTIONS AND MOLECULAR CONFORMATION IN SOME CRYSTAL STRUCTURES Ph.D. Thesis**
William Charles Schmidt, Jr. 1975 217 p
Avail: Univ. Microfilms Order No. 76-9

X-ray structural studies were undertaken on the system presented here to determine the effect of intramolecular interactions on certain molecular conformations. The crystallographic method and kinetic and X-ray studies on several nonplanar butadienes are discussed. The molecules studied include 2-diethoxycarbonylamino-3-carbamonyl-5 methylpyrazine-1-oxide, and 2-(3 prime-ketoindan-1 prime-ylidene)-1, 3-indandione. The structure of p-methoxycinnamic acid was analyzed as part of a study relating differences in molecular packing in cinnamic acid derivatives to differences in thermal mesomorphism displayed by these compounds. Solution of the structure resisted all standard direct methods and Patterson approaches, yielding finally to a rotation function approach where the square of the transform of the search fragment was fitted to the observed intensities.
Dissert. Abstr.

**N76-16952** Pittsburgh Univ., Pa.
**INVESTIGATIONS IN ELECTRON SPECTROSCOPY Ph.D. Thesis**
Thomas Paul Debies 1975 239 p
Avail: Univ. Microfilms Order No. 76-342

A variety of problems in electron spectroscopy are treated. The topics are presented in three sections: (1) gas phase ultraviolet photoelectron studies, (2) X-ray electron spectroscopic solid state studies and (3) photoionization cross sections. The gas phase ultraviolet photoelectron investigations deal with the electronic structure of substituted benzenes and some biologically important molecules. X-ray electron spectroscopy was employed to study the electronic structure and valence band density of states of indium antimonide, bismuth oxide, sulfide, selenide and telluride. General equations are given for calculating photoionization cross sections and angular distributions for polyatomic molecules in the plane-wave and orthogonalized plane-wave approximations.

Fully documented FORTRAN 4 computer programs used to compute the cross sections and angular distributions are also included. Dissert. Abstr.

**N76-16953** Northwestern Univ., Evanston, Ill.
**PHOTOEMISSION STUDIES OF ADSORPTION PHENOMENA ON PLATINUM Ph.D. Thesis**
Robert James Bastasz 1975 212 p
Avail: Univ. Microfilms Order No. 75-29573

The application of ultraviolet photoelectron spectroscopy to the study of adsorbed species on metallic surfaces is discussed. By comparing photoelectron spectra of a clean metallic sample recorded before and after exposure of the sample to a gas, it is possible to study the electronic interaction of chemisorbed gas with the metal surface. An ultrahigh vacuum electron spectrometer equipped with a He resonance lamp is described. The spectrometer is controlled by a small computer which also acquires digitized photoelectron spectra and intensity data. Samples were cleaned by etching with a beam of Ar ions. The photoelectron spectrum of clean polycrystalline platinum foil, obtained using a modulated etching technique, exhibits prominent d-band structure within 5.5 eV of the Fermi level. Photoelectron signals from Ar implanted in the foil as a result of etching are observed. Dissert. Abstr.

**N76-16954#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
**MAGNETIC BEHAVIOUR OF FIRST KIND SUPERCONDUCTING FILMS IN THE INTERMEDIATE THICKNESS REGION**
A. Rogani and E. Tabet 10 Jul. 1975 19 p refs
(ISS-P-75/7) Avail: NTIS HC $3.50

The Ginzburg-Landau equations are solved for first kind superconducting films of intermediate thickness. The parallel critical fields H sub cF are calculated as a function of temperature and specimen thickness. The theoretical values for H sub cF are compared with the existing experimental data for tin films at various temperature and thicknesses. Author

**N76-16955#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**ON THE DETERMINATION OF MICROSTRESSES IN POLYCRYSTALS**
V. M. Levin [1975] 7 p refs Transl. into ENGLISH from Issled. po Uprugosti i Plastichnosti (Leningrad), no. 10, 1974 p 37-47
Avail: NTIS HC $3.50; National Translations Center, John Crerar Library, Chicago, Illinois 60616

The perturbation method, without involving correlation functions, and its use to determine mean stress in polycrystal grains subjected to external loads, temperature changes, and phase transformation, are examined. Macroscopically, homogeneous, and isotropic polycrystals are considered, however, smallness of the grain anisotropy is not assumed. Final results are valid for materials for which the grain shape is almost spherical. Author

**N76-16956*#** Alabama Univ., Huntsville. Dept. of Physics.
**SPACE PROCESSING OF CRYSTALLINE MATERIALS: A STUDY OF KNOWN METHODS OF ELECTRICAL CHARACTERIZATION OF SEMICONDUCTORS Final Report**
J. G. Castle Jan. 1976 24 p ref
(Contract NAS8-30774)
(NASA-CR-144158) Avail: NTIS HC $3.50 CSCL 20L

A literature survey is presented covering nondestructive methods of electrical characterization of semiconductors. A synopsis of each technique deals with the applicability of the techniques to various device parameters and to potential in-flight use before, during, and after growth experiments on space flights. It is concluded that the very recent surge in the commercial production of large scale integrated circuitry and other semiconductor arrays requiring uniformity on the scale of a few microns, involves nondestructive test procedures which could well be useful to NASA for in-flight use in space processing. Author

**N76-16957*#** Westinghouse Research Labs., Pittsburgh, Pa.
**DESIGN, FABRICATION AND TEST OF PROTOTYPE FURNACE FOR CONTINUOUS GROWTH OF WIDE SILICON RIBBON Interim Report**
C. S. Duncan and R. G. Seidensticker 10 Dec. 1975 35 p refs
(Contract NAS3-19439)
(NASA-CR-134924; Rept-75-9C4-SIGRO-M7) Avail: NTIS HC $4.00 CSCL 20B

Progress is reported during the apparatus design, fabrication, and assembly phases of a program to grow wide, thin silicon dendritic web. The growth facility was essentially completed with any significant problems arising. A complete set of detailed fabrication drawings is included as an appendix. Author

**N76-16958#** California Inst. of Tech., Pasadena.
**ON THE CRITICAL TEMPERATURE OF SUPERCONDUCTORS**
S. J. Poon Jun. 1975 33 p refs
(Contract AT(04-3)-822)
(CALT-822-74) Avail: NTIS HC $4.00

An exact expression for the superconducting transition temperature is derived from the Eliashberg equation at T equals T/sub c/ taking the energy gap function in the two-square-well form. The expression is improved for self-consistency by using available tunneling data. It is found to give more restricted values of T/sub c/ than the McMillan equation. The prospects of obtaining high T/sub c/ in alloy systems are discussed within the framework of the equation. Author (NSA)

**N76-16959#** Knolls Atomic Power Lab., Schenectady, N.Y.
**EXCESS ENTROPY FOR A VACANCY IN A CRYSTAL**
D. M. Brudnoy Apr. 1975 46 p refs Sponsored by ERDA
(KAPL-M-7412) Avail: NTIS HC $4.00

The excess entropy for a single vacancy in any crystal with cyclic boundary conditions is given, within the small perturbation approximation, by DELTAS/k/sub B/ equals d/2, independent of crystal structure and particle interaction, dependent only on the dimensionality of the crystal, d. It is argued that the effect of free surface boundary conditions on DELTAS, within an exact theory, for any localized defect (not only a vacancy), is negligible. Using the vacancy perturbation result for DELTAS and Lawson's formula, a value for the vacancy formation volume is obtained only in terms of known measured parameters. If localized vibrational modes are present due to the vacancy, what effect these might have on DELTAS, and, from this, what materials might be candidates for observing these localized modes are discussed. Author (NSA)

**N76-16960#** Aeronautical Research Labs., Wright-Patterson AFB, Ohio.
**STUDY OF CRYSTAL GROWTH OF ZINC SELENIDE AND THE LOW TEMPERATURE EMISSION SPECTRA OF UNDOPED AND MONOVALENT METAL DOPED MELT GROWN ZINC SELENIDE Final Report, 1 Jul. 1974 - 30 Jun. 1975**
La Greene Jun. 1975 17 p refs
(AD-A015043; ARL-75-0196) Avail: NTIS CSCL 20/12

Recently there has been an increased interest in zinc selenide because of its possible application in the laser window problem. A better understanding of the defect structure of this material is to be desired. It is the purpose of this investigation to expand the study of the effects of native defects and residual impurities in zinc selenide on the emission spectra and through this study to obtain a better understanding of the nature and structure of the active centers formed from them and of their effects on the optical absorption in the spectral regions of interest to the Air Force. Melt grown crystals of zinc selenide, undoped and doped with sodium, lithium, sodium chloride, lithium chloride, and silver, were studied. The undoped crystals showed predominantly the I sub 1 deep series of lines believed to arise from the decay of an exciton bound to an acceptor. The sodium doped crystals showed predominantly the I sub 1 super Y exciton line believed to be associated with a sodium acceptor; the lithium doped crystals showed the I sub 1 super X line, believed to be associated with a lithium acceptor; the silver doped crystal showed lines not previously seen. GRA

**N76-16961#** Westinghouse Research Labs., Pittsburgh, Pa.
**INVESTIGATION OF FLUX PINNING AND CRITICAL CURRENT DENSITIES IN TYPE 2 SUPERCONDUCTORS Final Technical Report**

M. Ashkin, A. T. Santhanam, Michael R. Daniel, D. W. Deis, and D. M. Moon Aug. 1975 37 p refs
(Contract N00014-73-C-0026; NR Proj. 039-116)
(AD-A014623; Rept-75-9C31-FLPIN-R2; FTR-4) Avail: NTIS CSCL 20/12

Metallurgical techniques are developed for determining the microstructural features controlling the critical current of type 2 superconductors. The critical current in thin films is also examined by magnetization measurements. The critical current density and magnetic flux pinning forces are calculated as a function of field. Dislocation cell boundaries, the prominent microstructural feature of commercial multifilmmentary superconductors, is correlated with critical current and guidelines are provided for critical current enhancement in commercial conductors. A new technique is described for measuring grain size and thicknesses of the thin layers on the order of .5 micrometer which occur in the fabrication of Nb3Sn by diffusion reactions. The method is rapid and inexpensive compared to competing techniques. GRA

**N76-16962#** Westinghouse Research Labs., Pittsburgh, Pa.
**ELASTIC SURFACE AND BULK WAVE PHENOMENA Final Report, 1 Aug. 1969 - 31 Aug. 1974**
John DeKlerk 30 Aug. 1975 189 p refs
(Contract N00014-69-C-0118)
(AD-A014920; Rept-75-9G3-ACOUS-R1) Avail: NTIS CSCL 20/12

Contents: Characterization of piezoelectric materials for elastic surface wave devices; Fabrication of prototype delay line; Instrument for measurement of velocity and energy flow; Measurement of radiation resistance and reactance; Generation on quartz at harmonic frequencies; Rayleigh wave attenuation as a function of temperature; Interaction between surface waves and interdigital grids on LiNbO3 and SiO2; Rayleigh waves on YIG; Surface wave propagation in layered media; Optical probing of bulk wave generation by surface wave grids; Acoustic radiation measurement and calculations for three surface wave filter designs; Sensing presence of bulk elastic waves in piezoelectric media; Bulk wave/surface sensed pulse compression filter; Signal processing by means of steered bulk waves. GRA

**N76-16963#** Naval Research Lab., Washington, D.C.
**COOPERATIVE RADIATION EFFECTS SIMULATION PROGRAM Semiannual Progress Report, 1 Nov. 1974 - 30 Apr. 1975**
L. E. Steele and E. A. Wolicki Aug. 1975 109 p refs
(NRL Proj. M01-22; RR02103; RR0210302)
(AD-A015085; NRL-MR-3114) Avail: NTIS CSCL 20/12

The Cooperative Radiation Effects Simulation Program (CORES) is a collaborative effort of the Engineering Materials and Radiation Technology Divisions of the NRL Materials and General Sciences Area. The goal of the research is to provide the theoretical and experimental bases for understanding the mechanisms of void nucleation, as well as a theoretical insight into energy deposition processes. In this program the Van de Graaff and Cyclotron are used to simulate rapidly the radiation damage produced over long operating periods in reactor neutron environments. GRA

**N76-16964#** Monsanto Co., St. Louis, Mo. Electronics Div.
**THIN FILM OPTICAL WAVEGUIDES IN 3-5 SEMICONDUCTORS Final Report, 1 Jul. 1972 - 31 Dec. 1974**
David L. Keune, M. George Craford, Donald Finn, W. S. C. Chang (Washington Univ., St. Louis, Mo.), B. L. Sopori (Washington Univ., St. Louis, Mo.), Warren O. Groves (Washington Univ., St. Louis, Mo.), A. H. Herzog, and M. W. Muller Jan. 1975 163 p refs
(Contract F19628-72-C-0324; ARPA Order 2074)
(AD-A014863; AFCRL-TR-75-0279) Avail: NTIS CSCL 20/6

The objectives of this program are (1) to grow a variety of epitaxial GaAs, GaAsP, and GaAlAs waveguide structures, (2) to evaluate their performance for guided wave propagation, and (3) to use and to optimize them for device applications. Most of the samples were grown by the vapor phase epitaxial technique. A few samples were grown by the liquid phase epitaxial technique. The effect of layer thickness, alloy composition, surface quality and carrier concentrations on waveguide attenuation has been evaluated at 10.6 micrometers wavelength. Some attenuation data have also been collected at 1.06 micrometers. Waveguides with attenuation rate in the range of one to two db/cm have consistently been obtained at both 10.6 micrometers and 1.06 micrometers. The use of these waveguides for electrooptical modulation at 10.6 micrometers wavelength was analyzed and demonstrated. Comparison of the various waveguides and optimization of the waveguide design for electrooptical modulation has been carried out. A limited amount of effort has also been made to investigate grating couplers and fiber to film coupling. GRA

# 77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

**N76-16965** Montana Univ., Missoula.
**ORDER RELATIONS IN THERMODYNAMICS Ph.D. Thesis**
Terry David Lenker 1975 55 p
Avail: Univ. Microfilms Order No. 76-648

Let the topological space S be the state space of a thermodynamic system S, define r is less than or approximately equal s if s can be attained from r by means of an adiabatic process performed on script. The results of physical experimentation show that this relation is a quasi-order. A real-valued function defined on S which preserves this order relation is called an empirical entropy function. An expository account is given of known sufficient conditions on the order relation and the state space S which guarantee the existence of a continuous empirical entropy function. A statement on the zero-th law of thermodynamics is used to establish an equivalence relation on the state space S. Sufficient conditions are given for there to exist an order relation less than or equal defined on S such that the order topology induced on S by the relation less than or equal is compatible with the original topology on S. Dissert. Abstr.

**N76-16966** California Univ., Davis.
**THE THERMODYNAMIC LIMIT FOR NONUNIFORM CLASSICAL CONTINUUM SYSTEMS Ph.D. Thesis**
Carver Stephen Simmons 1975 168 p
Avail: Univ. Microfilms Order No. 76-1807

The thermodynamic limit of a classical system with many-body interactions and under the influence of an external potential was investigated for the ensembles of statistical mechanics. By scaling the external potential to a sequence of domains which are isotropic expansions of an initial domain confining the system, it is shown that the entropy per particle, the free energy per particle, and the pressure have infinite system limits, provided that consideration is restricted to internal interactions which have the property that separated groups of particles have negligible mutual attractive energy as the system becomes infinite. It is shown that the scale thermodynamic limit yields the thermodynamic description of a continuum system acted upon by a macroscopic external force. It is demonstrated that there exists a large class of many-body interactions which have the required separation property. An example is a two-body interaction which includes a hard core. Dissert. Abstr.

# 80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

**N76-16967*#** National Aeronautics and Space Administration, Washington, D.C.
**NASA'S UNIVERSITY PROGRAM: ACTIVE GRANTS AND RESEARCH CONTRACTS, FISCAL YEAR 1975**
1975 347 p refs
(NASA-TM-X-72845) Avail: NTIS HC $3.50 (special price) CSCL 05I

Active university research projects for Fiscal Year 1975 are

reported by state, and foreign country. Cross indexes by: (1) grant/contract number; (2) field of science and engineering; (3) technical officer location; and (4) RTOP are included. Author

**N76-16968*#** Joint Publications Research Service, Arlington, Va.
**RIGA CIVIL AVIATION TECHNICAL SCHOOL**
N. A. Ovsiyenko Washington NASA Feb. 1976 20 p Transl. into ENGLISH from "Rizhskoye Letno-Tekhnicheskoye Uchilishche Grazhdanskoy Aviatsii" Riga, 1975 p 1-19
(NASA Order W-13183)
(NASA-TT-F-16868) Avail: NTIS HC $3.50 CSCL 05I

A brochur3 describing the training programs for air traffic controllers and radio technicians at the Riga Civil Aviation Technical School is presented. A physical description is given of the school, its campus, and equipment. E.H.W.

**N76-16969*#** Joint Publications Research Service, Arlington, Va.
**KIEV CIVIL AVIATION ENGINEERING INSTITUTE**
Washington NASA Feb. 1976 30 p Transl. into ENGLISH from "Kiyevskiy Institut Inzhenerov Grazhdanskoy Aviatsii, USSR Min. of Civil Aviation" Moscow, 1972 p 1-28
(NASA Order W-13183)
(NASA-TT-F-16867) Avail: NTIS HC $4.00 CSCL 05I

A brochure is presented on the activities of the Kiev Institute and its efforts to increase the volume of passenger service, and to put into service new, luxurious, fast, and more economical aircraft. The Institute was also charged with enlarging airport networks serving both major cities and smaller towns. The brochure contains data on the school campus, training programs, and equipment used to train engineers, technicians, and pilots. E.H.W.

# 81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**N76-16970** Kansas Univ., Lawrence.
**A DECISION MAKING APPROACH TO TECHNOLOGY ASSESSMENT Ph.D. Thesis**
Yuen-Sun Fu 1975 92 p
Avail: Univ. Microfilms Order No. 75-30030

In order to prescribe a group decision, a procedure for weighting individual gains and probabilities is studied. The theoretical development is divided into four parts. First, methods are proposed for compromising the assessments of various individuals into a single set of assessments for the entire group. A best group decision is defined as the one that maximizes the expected group gain across the several proposed methods. Second, methods are developed for computing the expected group burden of uncertainty. This quantitative value not only measures the risk introduced by uncertainty but also provides decision makers an upper limit on the amount of uncertainty that can be removed by experimentation. Third, from the expected burden of uncertainty concept, methods are developed for determining the weighting constants which are the relative weights used for compromising the individual's assessments. Finally, a computational algorithm for group decision making is presented. Examples are given in each development as illustrations. Dissert. Abstr.

**N76-16971*#** National Academy of Public Administration, Washington, D.C.
**ACHIEVING EQUAL OPPORTUNITY IN NASA: AN ASSESSMENT OF NEEDS AND RECOMMENDATIONS FOR ACTION**
Jan. 1976 74 p refs
(Contract NASw-2351)
(NASA-CR-146356) Avail: NTIS HC $4.50 CSCL 05A

Measures designed by NASA to improve its equal opportunity program are reported. Attempts made to increase the ratios and level of placement of women and minority men in the work force were emphasized, upward mobility for those employees already in the work force was also studied. Ways for improving the track record for NASA's equal opportunity profile are recommended. E.H.W.

**N76-16972#** California Inst. of Tech., Pasadena. Div. of Humanities and Social Sciences.
**GOVERNMENT POLICIES AND TECHNOLOGICAL INNOVATION. VOLUME 1: PROJECT SUMMARY Final Report**
Roger G. Noll May 1975 40 p 5 Vol.
(Grants NSF DA-39495; NSF RDA-73-07241)
(PB-244571/6; NSF/RDA-73/4/1-Vol-1) Avail: NTIS HC $4.00 HC also available $42.00/set of 5 reports as PB-244570-SET CSCL 05A

The issue of whether the existing state of knowledge in social science research provides an adequate information base for making decisions about public policies that affect technological innovation is discussed. The principal conclusions of the study are (1) the state of social science literature on matters relating to technological innovation is far too undeveloped to warrant many strong conclusions with respect to government policy to alter innovative behavior; (2) the most effective type of policy for increasing innovative performance in areas where it is deemed socially desirable to do so is likely to be a system of grants and prizes for specific projects, administered by several agencies having overlapping responsibilities; and (3) generalized public policies applied more or less evenly across all industries are virtually certain to be inefficient, providing too little incentive to innovate in some areas and increasing the appropriability of some innovations beyond that which is necessary to induce them. GRA

**N76-16973#** California Inst. of Tech., Pasadena. Div. of Humanities and Social Sciences.
**GOVERNMENT POLICIES AND TECHNOLOGICAL INNOVATION. VOLUME 2-A AND VOLUME 2-B: STATE-OF-THE-ART SURVEYS Final Report**
Roger G. Noll Nov. 1974 239 p refs 5 Vol.
(Grants NSF DA-39495; NSF RDA-73-07241)
(PB-244572/4; NSF/RDA-73/4/2-Vol-2-A; NSF/RDA-73/4/2-Vol-2-B) Avail: NTIS HC $8.00 HC also available $42.00/set of 5 reports as PB-244570-SET CSCL 05A

State-of-the-art literature reviews are presented on the following subjects: a review and decision theoretic literature with implications regarding governmental research and development policies; patent policy, technological innovation, and government contracts--a selective critique; institutional structure and technological charge; market structure and R&D; a dynamic theory of competition; the market for innovation; public policy and innovation--two cases; government administrative behavior and technological innovation. GRA

**N76-16974#** California Inst. of Tech., Pasadena. Div. of Humanities and Social Sciences.
**GOVERNMENT POLICIES AND TECHNOLOGICAL INNOVATION. VOLUME 3: RESEARCH AND POLICY STUDIES Final Report**
Roger G. Noll May 1975 173 p refs 5 Vol.
(Grants NSF DA-39495; NSF RDA-73-07241)
(PB-244573/2; NSF/RDA-73/4/3-Vol-3) Avail: NTIS HC $6.75 HC also available $42.00/set of 5 reports as PB-244570-SET CSCL 05A

Research and policy studies are presented on the following subjects: factor bias and innovations--a microeconomic approach; the consequences of public utility regulation of hospitals; background memorandum--the regulation of atomic energy for power generation; comments regarding limitations on programming available for broadcast on pay-TV channels; on comparative dynamics; rate regulation and freight traffic allocation--a review and revision; the public policy issues involved in dealing with environmental degradation--a dynamic approach; separability and vanishing externalities; stability of pure trade equilibrium with externalities; patent provisions in federal research and development contract policy. GRA

**N76-16975#** California Inst. of Tech., Pasadena. Div. of Humanities and Social Sciences.
**GOVERNMENT POLICIES AND TECHNOLOGICAL INNOVATION. VOLUME 4 (A, B, AND C): ABSTRACTS Final**

**Report**
Roger G. Noll Oct. 1974 518 p refs 5 Vol.
(Grants NSF DA-39495; NSF RDA-73-07241)
(PB-244574/0; NSF/RDA-73/4/4-Vol-4/A/B/C) Avail: NTIS HC $12.75 HC also available $42.00/set of 5 reports as PB-244570-SET CSCL 05A

Abstracts are presented of the books and articles read in connection with the state-of-the-art surveys. They are organized under the following headings: decision theory and project management; case studies of innovation; bureaucratic behavior; public policies towards health and environmental resources; the market for innovation; market structure; rights to knowledge; public policy proposals. GRA

**N76-16976#** California Inst. of Tech., Pasadena. Div. of Humanities and Social Sciences.
**GOVERNMENT POLICIES AND TECHNOLOGICAL INNOVATIONS. VOLUME 5 (A AND B): BIBLIOGRAPHY Final Report**
Roger G. Noll Oct. 1974 233 p refs 5 Vol.
(Grants NSF DA-39495; NSF RDA-73-07241)
(PB-244575/7; NSF/RDA-73/4/5-Vol-5/A/B) Avail: NTIS HC $8.00 HC also available $42.00/set of 5 reports as PB-244570-SET CSCL 05A

A complete bibliography is presented of all items perused in compiling the state-of-the-art surveys. State of the art literature reviews are included on the following subjects: decision theory and project management; case studies of innovation; Bureaucratic behavior; public policies towards health and environmental resources; the market for innovation; market structure; rights to knowledge; public policy proposals. GRA

**N76-16977#** Real Estate Research Corp., Chicago, Ill.
**ENERGY, LAND USE, AND GROWTH POLICY: IMPLICATIONS FOR METROPOLITAN WASHINGTON, SECOND EDITION Final Report**
James S. Roberts Aug. 1975 118 p
(Grant HUD-CPA-DC-1011)
(PB-245249/8) Avail: NTIS HC $5.50 CSCL 10A

Plans xor a workshop to be held to obtain recommendations for the National Science Foundation on specific industrial productivity problems are outlined. Discussion and question and answer sessions will be aimed at formulating research projects or objectives that would aid productivity. For the workshop purpose, a definition of industrial productivity includes all actions contributing to industry-wide efficiency, total product cost, and production volume. Six industries, automotive, electrical machinery machine tool, household appliances, food processing, and iron and steel, were selected for study. A list of problem areas and questions, researchable problem guidelines, and a list of questions for the industry participants are included. GRA

**N76-16978#** Army Missile Command, Redstone Arsenal, Ala. Systems Analysis Office.
**DATA ESTIMATES AND SUBJECTIVE PROBABILITY, A REVIEW Final Report**
Michael J. Dorsett Aug. 1975 21 p refs
(AD-A015551; C-TN-75-2) Avail: NTIS CSCL 05/10

This paper addresses subjective probabilities and estimates of uncertain events in the future. The discussion is concerned with estimator's ability to provide estimates. Tversky and Kahneman have found that three heuristics describe the factors which determine an individual's estimate. The basic conclusion one can reach is that individual or group subjective estimates are still a measure of belief. GRA

**N76-16979#** Oregon Research Inst., Eugene.
**BEHAVIORAL FOUNDATIONS OF DECISION ANALYSIS Final Technical Report**
Paul Slovic 6 Aug. 1975 14 p
(Contract N00014-73-C-0438; ARPA Order 2449; NR Proj. 197-026)
(AD-A015369) Avail: NTIS CSCL 05/10

This paper summarizes the work done by the Institute in the areas of probability assessment, prediction and choice; evaluation of past decisions; and decision theory. Twelve completed reports and six studies in progress are described. GRA

# 82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

**N76-16980#** National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.
**CRITICAL EVALUATION OF DATA IN THE PHYSICAL SCIENCES. A STATUS REPORT ON THE NATIONAL STANDARD REFERENCE DATA SYSTEM, APRIL 1975**
Stephen A. Rossmassler Sep. 1975 56 p
(COM-75-11284/7; NBS-TN-881; LC-75-600066) Avail: NTIS HC $4.50 CSCL 14B

Current activities and functions of the Office of Standard Reference Data are summarized. A complete list of data evaluation projects supported by the Office of Standard Reference Data during Fiscal Year 1975 is included; this list also includes projects which received financial support during the previous fiscal year, and which are still actively involved in some aspect of data compilation and evaluation. The list of projects includes continuing data centers in the United States whose activities fall within the scope of the system, but which are not formally affiliated with it. A list of publications resulting from the Standard Reference Data program is provided. GRA

**N76-16981#** Operations Research, Inc., Silver Spring, Md.
**CONCEPT DEFINITION OF THE ARMY ENVIRONMENTAL TECHNICAL INFORMATION SYSTEM Final Report**
Fred S. Zuzman, Mary K. Harmon, Beverley D. Sharp, and Howard J. VanDerSluis 15 Apr. 1975 181 p refs
(Contract DAMD17-74-C-4114)
(AD-A015014; ORI-TR-893) Avail: NTIS CSCL 05/2

The objectives of this study were to analyze the user requirements for Army Environmental Technical Information System and to develop a detailed design and an implementation plan for the system. Over 50 individuals were interviewed in 19 government agencies and offices to determine current patterns of generation and use of environmental information. An analysis of these current methods and resources is presented and a system structure is proposed that will improve the effectiveness and efficiency of the present methods for meeting the needs of the Army for environmental information. GRA

# 83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

**N76-16982*#** Aerospace Corp., El Segundo, Calif. Advanced Mission Analysis Directorate.
**SYSTEMS COST/PERFORMANCE ANALYSIS (STUDY 2.3). VOLUME 2: SYSTEMS COST/PERFORMANCE MODEL Final Report**
B. H. Campbell 31 Mar. 1975 595 p refs Supersedes ATR-74(7343)-1-Vol-2
(Contract NASw-2727)
(NASA-CR-146132; ATR-75(7363)-3-Vol-2; ATR-74(7343)-1-Vol-2) Avail: NTIS HC $13.75 CSCL 05C
For abstract, see N76-16892.

# 84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

**N76-16983*#** Scientific Translation Service, Santa Barbara, Calif.
**BASIC STRUCTURE OF THE PEACE TREATY**
Fumio Ikeda Washington NASA Feb. 1976 83 p refs

Transl. into ENGLISH of J. Intern. Laws (Japan), v. 67, no. 1, 1970 62 p
(Contract NASw-2791)
(NASA-TT-F-16863) Avail: NTIS HC $5.00 CSCL 05D

The basic principles of exploration and utilization of space are discussed along with the creation of legal order in space. Topics covered in the treaty include international cooperation in space, prohibition of territorial occupation, regulation of activities in space, the legal standpoint of space flight, and international space organizations. M.J.S.

**N76-16984#** Committee on Science and Technology (U. S. House).
**EPA R AND D AUTHORIZATION, FISCAL YEAR 1976**
Washington GPO 1975 347 p refs Hearings before Subcomm. on the Environment and the Atmosphere of Comm. on Sci. and Technol., 94th Congr., 1st Sess., 4-6 Mar. 1975
(GPO-50-275) Avail: Subcomm. on the Environment and the Atmosphere

The Environmental Protection Agency research and development program is reviewed along with the budget for FY 1976. The organizational structure and effectiveness of the Office of Research and Development is also discussed in terms of acceptance and/or resistance to proposed environmental standards. J.M.S.

# 85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

**N76-16985*#** National Aeronautics and Space Administration, Washington, D.C.
**SPINOFF 1976**
Neil P. Ruzic 1976 107 p Original contains color illustrations
(NASA-SP-5121) Avail: NTIS HC $5.50 CSCL 05H

This report is divided into three sections: 1. The Research Payoff, 2. Technology Twice Used, and 3. Technology Utilization at Work. The first describes a wide variety of current space spinoffs of use in business or personal life, as well as the space explorations from which they have been derived. The second provides information on specific examples of technology transfer that are typical of the spinoffs resulting from NASA's Technology Utilization Program. The third briefly describes the different activities of the Technology Utilization Office, all of which have as their purpose the profitable utilization of aerospace technology. Author

**N76-16986#** Uniflo Systems Co., Minneapolis, Minn.
**PERFORMANCE EVALUATION OF AN AIR-LEVITATED AIR-PROPELLED, PASSIVE VEHICLE PERSONAL RAPID TRANSIT SYSTEM Final Report, Oct. 1972 - Jun. 1974**
Charles H. Smoot Jun. 1975 117 p
(Contract DOT-TSC-367)
(PB-244454/5; DOT-TSC-UMTA-75-3; UMTA-75-3; UMTA-MA-06-0031-75-1) Avail: NTIS HC $5.50 CSCL 13F

An eight-passenger Uniflo vehicle was tested to 30 ft/sec on enclosed guideway through curved straight and switch sections. The following parameters were measured: ride quality, as 3 axis acceleration, noise emission as perceived by passengers in area near guideway, vehicle acceleration and service braking, switch response time, levitation air flow and power requirements, propulsion air flow and power requirements, and performance and reliability between -20 F and +90 F. GRA

# 88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

# 89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

**N76-16987** Michigan Univ., Ann Arbor.
**A STUDY OF PECULIAR A STARS IN GALACTIC CLUSTERS Ph.D. Thesis**
Mark Richard Hartoog 1975 66 p
Avail: Univ. Microfilms Order No. 75-29238

MK spectral types were determined for 263 B and A stars in the southern galactic clusters NGC 2287, 2422, 2451, 2516, 2547, 3228, and 3532 in order to investigate the frequency of Ap stars in galactic clusters. It was concluded that Ap stars of the Hg-Mn type could not be reliably identified at classification dispersion. Only Ap stars of the Si, Sr, Cr, or Eu types were considered. If one disregards photometric membership criteria for the Ap stars but not the normal stars, then there are 11 Ap stars and 203 normal B5 to A5 stars in these clusters. This frequency is lower than that found in two field samples. When this sample is combined with published data for other clusters, one has a sample which includes 38 Ap stars and 744 normal B5 to A5 stars. A chi squared test indicates that this frequency is lower than the field frequency at the 98.8 percent and 96.6 percent confidence levels for two field samples. Several systematic effects that may have influenced this result are investigated. Dissert. Abstr.

**N76-16988** Virginia Univ., Charlottesville.
**THE PERFORMANCE LIMITS OF THE ASTROMETRIC MULTIPLEXING AREA SCANNER Ph.D. Thesis**
Harold Alister McCalister 1975 111 p
Avail: Univ. Microfilms Order No. 76-1076

The astrometric multiplexing area scanner (AMAS) is an instrument designed to perform photoelectric long-focus astrometry of small fields, replacing both the photographic plate and the measuring engine. Observations of double and multiple star systems have indicated a lower limit to resolution of approximately 4 arcseconds. The results presented here were made to check the above result and to provide additional data on the overall precision and accuracy of the AMAS. The basic observations were made in the laboratory under precisely controlled conditions using near Gaussian artificial double star images with separation adjustable in 10.3 + or - 1.2 mu steps in the ruling plane. The existing reduction technique is modified to more properly consider the signal d.c. term and to calculate the image radius. The data are used to evaluate instrumental precision, accuracy and resolution characteristics with respect to a variety of instrumental and cosmical parameters that include distance from ruling center, signal/noise, record length and binary star separation, position angle and magnitude difference. Dissert. Abstr.

**N76-16989*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EVIDENCE FOR AN 11.2d PERIODICITY FROM CYG X-2**
S. S. Holt, E. A. Boldt, P. J. Serlemitsos, and L. J. Kaluzienski (Maryland Univ., College Park) Jan. 1976 11 p refs Submitted for publication
(NASA-TM-X-71049; X-660-76-1) Avail: NTIS HC $3.50 CSCL 03A

Evidence for a persistent 11.17 + or - .10d period from Cyg X-2 is presented from one year of accumulated data from the Ariel-5 all-sky monitor. The effect is not a simple sidereal alias of a true source period close to one day. Author

**N76-16990*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE EVOLUTION OF ROTATING STARS. 1: METHOD AND EXPLORATORY CALCULATIONS FOR A 7 SOLAR MASS STAR**
A. S. Endal and S. Sofia (NASA, Washington) Jan. 1976 67 p refs
(NASA-TM-X-71050; X-671-76-9) Avail: NTIS HC $4.50 CSCL 03A

A method was developed which allows us to study the evolution of rotating stars beyond the main sequence stage. Four different cases of redistribution of angular momentum in an evolving star are considered. Evolutionary sequences for a 7 solar mass star, rotating according to these different cases, were computed from the ZAMS to the double shell source stage. Each sequence was begun with a (typical) equatorial velocity of 210 km/sec. On the main sequence, the effects of rotation are of minor importance. As the core contracts during later stages, important effects arise in all physically plausible cases. The outer regions of the cores approach critical velocities and develop unstable angular velocity distributions. The effects of these instabilities should significantly alter the subsequent evolution.
Author

**N76-16991#** Aerospace Corp., El Segundo, Calif.
**A TIME-OF-FLIGHT TELESCOPE FOR MEASURING THE ISOTOPIC COMPOSITION OF INTERPLANETARY AND MAGNETOSPHERIC PARTICLES IN THE ENERGY RANGE OF 0.280 TO 3.5 MeV/NUCLEON**
J. Bernard Blake and Norman Katz 30 Aug. 1975 18 p refs
(Contract F04701-75-C-0076)
(AD-A015078; TR-0076(6260-20)-6; SAMSO-TR-75-226) Avail: NTIS CSCL 03/2

A satellite instrument for the detection of very low-energy cosmic rays and geomagnetically trapped ions which employs a thin plastic scintillator foil and a silicon semiconductor detector in a time-of-flight configuration is described. The motivation for using such a sensor is to be discussed briefly and the configuration, electronic design, and response of the instrument is described in some detail.
GRA

# 90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

**N76-16992** Princeton Univ., N.J.
**SPIN AND TORSION IN GENERAL RELATIVITY: FOUNDATIONS, AND IMPLICATIONS FOR ASTROPHYSICS AND COSMOLOGY Ph.D. Thesis**
George David Kerlick 1975 191 p
Avail: Univ. Microfilms Order No. 76-253

A generalization of Einstein's (1915) general relativity due to Cartan (1922, 1923) Sciama (1962), and Kibble (1961) [ESCK] is reviewed, in its geometrical aspects and in its physical aspects. The foundations of the theory are examined from the point of view of local gauge invariance and the geometrical language of fibre bundle theory. It is shown that invariance under spacetime translations leads to Einstein's theory, and that local Lorentz invariance, which by itself leads to no satisfactory physical theory, can be related to the contortional degree of freedom in the Riemann-Cartan geometry of ECSK. For the physical theory simple solutions of the Dirac equation in Riemann-flat space-times with torsion are examined. From this examination it was found that th3 gravitational spin-spin interaction which distinguishes ECSK from general relativity is attractive between electrons, positrons, neutrinos, and antineutrinos whenever their spin polarizations are aligned. Cosmological models with torsion were studied for matter described as convective 'spinning dust' and for matter fields which solve the ECSK-Dirac equations.
Dissert. Abstr.

**N76-16993*#** Old Dominion Univ. Research Foundation, Norfolk, Va.
**EARTH-MOON SYSTEM: DYNAMICS AND PARAMETER ESTIMATION Semiannual Progress Report, 17 Feb. - 17 Aug. 1975**
W. J. Breedlove, Jr. Dec. 1975 118 p refs
(Grant NsG-1152)
(NASA-CR-146212; TR-75-M5) Avail: NTIS HC $5.50 CSCL 03B

A theoretical development of the equations of motion governing the earth-moon system is presented. The earth and moon were treated as finite rigid bodies and a mutual potential was utilized. The sun and remaining planets were treated as particles. Relativistic, non-rigid, and dissipative effects were not included. The translational and rotational motion of the earth and moon were derived in a fully coupled set of equations. Euler parameters were used to model the rotational motions. The mathematical model is intended for use with data analysis software to estimate physical parameters of the earth-moon system using primarily LURE type data. Two program listings are included. Program ANEAMO computes the translational/rotational motion of the earth and moon from analytical solutions. Program RIGEM numerically integrates the fully coupled motions as described above.
Author

**N76-16994*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**OBSERVATIONS OF THE INTERPLANETARY MAGNETIC FIELD BETWEEN 0.46 AND 1 A.U. BY THE MARINER 10 SPACECRAFT Ph.D. Thesis - Catholic Univ. of Am.**
Kenneth W. Behannon Jan. 1976 234 p refs
(NASA-TM-X-71043; X-692-76-2) Avail: NTIS HC $8.00 CSCL 03B

Almost continuous measurement of the interplanetary magnetic field (IMF) at a sampling rate of 25 vectors/sec was performed by the magnetic field experiment onboard the Mariner 10 spacecraft during the period November 3, 1973 to April 14, 1974, comprising approximately 5-2/3 solar rotations and extending in radial distance from the sun from 1 to 0.46 AU. A clearly discernible two-sector pattern of field polarity was observed during the last 3-1/2 months of the period, with the dominant polarity toward the sun below the solar equatorial plane. Two compound high-speed solar wind streams were also present during this period, one in each magnetic field sector. Relative fluctuations of the field in magnitude and direction were found to have large time variations, but on average the relative magnitude fluctuations were approximately constant over the range of heliocentric distance covered while the relative directional fluctuations showed a slight decrease on average with increasing distance. The occurrence rate of directional discontinuities was also found to decrease with increasing radial distance from the sun.
Author

**N76-16995*#** California Univ., Berkeley. Space Sciences Lab.
**RELATIVISTIC ASTROPHYSICS Semiannual Report, 1 May - 31 Oct. 1975**
P. Buford Price 10 Feb. 1976 25 p refs
(Grant NGR-05-003-376)
(NASA-CR-146160; SSL-Ser-17-Issue-7) Avail: NTIS HC $3.50 CSCL 03B

The design, experimental testing, and calibration (error analysis) of a high resolution Cerenkov-scintillation detector is presented. The detector is capable of detecting iron isotopes and heavy ions of cosmic rays, and of performing direct measurements of individual neighboring isotopes at charge resolution 26. It utilizes Lexan (trademark) sheets, and has been used in flight packages of balloons and on the Skylab. The detector will be able to provide more information on violet astrophysical processes, such as thermonuclear reactions on neutron stars. Ground support and display equipment which are to be used in conjunction with the detector are also discussed.
J.R.T.

**N76-16996*#** Stanford Univ., Calif. Inst. for Plasma Research.
**APPROXIMATE SOLUTIONS OF RADIATIVE TRANSFER IN DUSTY NEBULAE. 2: HYDROGEN AND HELIUM**
Roger A. Dana and Vahe Petrosian Aug. 1975 33 p refs Submitted for publication
(Grants NGR-05-020-510; NsG-2049)
(NASA-CR-146392; SU-IPR-637) Avail: NTIS HC $4.00 CSCL 03B

The ionization structure of hydrogen and helium in dusty nebulae is discussed. The general equations for pure hydrogen nebulae are modified to include helium. An approximate analytic solution is presented for Stroemgren radii of hydrogen and helium in the absence of dust. It is shown that these results, with simple modifications, are also applicable to dusty nebulae where the effective absorption cross section of dust grains varies slowly with frequency in the 1000 to 200A range. No analytic solutions are possible if this cross section varies rapidly with frequency. In this case, however, simple coupled differential equations are derived. Approximate analytic expressions are presented for evaluation of the variation of the fraction of ionizing radiation absorbed by dust and the ratio of the volume emission measures of He II to H II regions with the spectrum of the ionizing source, helium abundance, and absorption properties of dust. The effects of dust on the He III zone are discussed. Results are restricted to spherically symmetric nebulae, but nonuniform gas and dust distributions and clumpiness can be taken into account. Author

**N76-16997#** Los Alamos Scientific Lab., N.Mex.
**RECENT OBSERVATIONS RELATING TO THE DYNAMICS AND ORIGIN OF THE MAGNETOTAIL PLASMA SHEET**
E. W. Hones, Jr. 1975 28 p refs Presented at the Nobel Symp. on the Phys. of the Hot Plasma in the Magnetosphere, Kiruna, Swed., 2-4 Apr. 1975
(Contract W-7405-eng-36)
(LA-UR-75-791; Conf-750461-1) Avail: NTIS HC $4.00

This paper reviews the substorm behavior of the plasma sheet and the evidence that a substorm expansive phase onset signals the sudden formation of a magnetic neutral line across a near region of the magnetotail. The neutral line forms at distances less than approximately 18 R/sub E/ in moderate to intense substorms, but at distances greater than approximately 30 R/sub E/ in weak substorms, or substorms detected only at high latitudes (on the contracted auroral oval). Several types of observations are presented as evidence that solar wind plasma enters the plasma sheet via convection along the cleft, through the magnetotail surface layer, through the magnetotail lobes and finally earthward from a magnetotail neutral line. These observations were made, however, during periods of southward interplanetary magnetic field; possibly this is a less effectual route for plasma entry to the plasma sheet when the IMF is northward. Author (NSA)

**N76-16998#** Pennsylvania Univ., Philadelphia. Dept. of Physics.
**NEUTRINO ASTROPHYSICS**
S. A. Bludman 17 Jan. 1975 36 p refs Presented at 7th Tex. Symp. on Relativistic Astrophys., Dallas, 17 Dec. 1974 Sponsored by ERDA
(COO-3071-113; Conf-741215-3; UPR-0036T) Avail: NTIS HC $5.00

Neutrino or antineutrino emission from collapsing or bouncing stars is considered. Up to 10 to the 15th power GM to the 15th power cm, a hot neutron fluid behaves like an ideal gas and the neutron-proton ratio is generally less than that of a cold neutron star. The neutrino diffusion approximation is expected to be valid down to e sub upsilon equals 8 MeV, but the Fermi statistics and the energy dependence of weak cross-sections lead to important differences between photon and neutrino emitting stars. From the energy release in collapse of a degenerate core to neutron star radius and the dynamics of free-fall, a period T approximately 1 ns and pulse width DELTA I greater than 14 mu s is expected. The dynamics of rich clusters of galaxies is discussed. It is shown that the cluster missing mass cannot be attached to massive superhalos about the galaxies but must be in intergalactic objects of lower mass. NSA

# 91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

**N76-16999*#** Avco Corp., Wilmington, Mass.
**STUDY OF THE ABLATIVE EFFECTS ON TEKTITE Final Report**
Karl K. Chen Jun. 1975 42 p refs
(Contract NAS5-20541)
(NASA-CR-144708; AUSD-0249-75-CR) Avail: NTIS HC $4.00 CSCL 03B

The tumbling and surface roughness effects on the trajectory of entry tektite were studied in both free molecular and continuum flows. It is shown that, while surface roughness has negligible effect on trajectory, the tumbling may play an important role in tektite trajectory and the consequent ablation, provided the body shape is different from a sphere. A shape factor B was proposed to measure the shape irregularity and is found to be a good parameter for correlations between body shape and tumbling effects. Author

**N76-17000*#** Massachusetts Inst. of Tech., Cambridge. Remote Sensing Lab.
**MULTISPECTRAL MAPPING OF THE LUNAR SURFACE USING GROUNDBASED TELESCOPES**
Thomas B. McCord, Carle Pieters, and Michael A. Feirberg Jan. 1976 47 p refs
(Grant NGR-22-009-790)
(NASA-CR-146136; MITRSL-137) Avail: NTIS HC $4.00 CSCL 03B

Images of the lunar surface were obtained at several wavelengths using a silicon vidicon imaging system and ground-based telescopes. These images were recorded and processed in digital form so that quantitative information is preserved. The photometric precision of the images is shown to be better than 1 percent. Ratio images calculated by dividing images obtained at two wavelengths (0.40/0.56 micrometer) and 0.95/0.56 micrometer are presented for about 50 percent of the lunar frontside. Spatial resolution is about 2 km at the sub-earth point. A complex of distinct units is evident in the images. Earlier work with the reflectance spectrum of lunar materials indicates that for the most part these units are compositionally distinct. Digital images of this precision are extremely useful to lunar geologists in disentangling the history of the lunar surface. Author

**N76-17001*#** Arkansas Univ., Monticello.
**GEOLOGIC STRUCTURE OF SHALLOW MARIA**
Rene A. DeHon and John A. Waskom Dec. 1975 96 p refs (Contract NAS9-13196)
(NASA-CR-147400) Avail: NTIS HC $5.00 CSCL 03B

Isopach maps and structural contour maps of the eastern mare basins (30 deg N to 30 deg S; 0 deg to 100 deg E), constructed from measurements of partially buried craters, are presented and discussed. The data, which are sufficiently scattered to yield gross thickness variations, are restricted to shallow maria with less than 1500-2000 m of mare basalts. The average thickness of basalt in the irregular maria is between 200 and 400 m. Correlations between surface topography, basalt thickness, and basin floor structure are apparent in most of the basins that were studied. The mare surface is commonly depressed in regions of thick mare basalts; mare ridges are typically located in regions of pronounced thickness changes; and arcuate mare rilles are confined to thin mare basalts. Most surface structures are attributed to shallow stresses developed within the mare basalts during consolidation and volume reduction. Author

**N76-17002*#** State Univ. of New York, Geneseo. Dept. of Geological Sciences.
**SELECTED ASPECTS OF LUNAR MARE GEOLOGY FROM APOLLO ORBITAL PHOTOGRAPHY Final Report**
Richard A. Young and W. J. Brennan Jan. 1976 177 p refs

latitude (+60 deg) is found to be steeply rising at energies less than 0.28 keV with an integrated energy flux of 29 keV sec sq cm sterad between 0.1 and 0.28 keV. Data obtained in a single slow scan of the Galaxy, beginning near the plane in the anticenter direction and ending at galactic latitude +60 deg., show a qualitative correlation with 21-cm hydrogen data only from intermediate (+30 deg) to high galactic latitude.

Dissert. Abstr.

**N76-17016#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**MEASUREMENT OF HARD SOLAR COSMIC RAY STREAMS IN THE STRATOSPHERE DURING THE INTRUSION OF 4-8 AUGUST 1972**
V. V. Vorobev, N. N. Mikirova, and V. Iu. Prichesniaev [1975] 7 p refs Transl. into ENGLISH from Trudy Inst. Prikl. Geofiz. (USSR), no. 29, 1974 p 15-22
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The spectra of intruding protons in the 200 - 500 Mev range were determined by using measurements from sounding balloons. Proton fluxes incident on the boundary of the atmosphere were computed and the exponent alpha was determined for a power law function describing the spectrum. The time history of proton fluxes was also obtained and diffusion coefficients were estimated on the basis of a generalized isotropic diffusion model. The dose intensity in the stratosphere was computed for the events of 4 - 8 August. As a result of the computations it was found that the maximum dose intensity is elevated for the passengers of high altitude aircraft flying in polar regions. Author

**N76-17017*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**IMPLICATIONS FOR FLARE BUILD-UP AND HEATING FROM OBSERVATIONS MADE BY OSO-7**
W. M. Neupert Nov. 1975 10 p refs Presented at the Flare Build-Up Study Workshop, Cape Cod, Mass., 8-11 Sep. 1975 (NASA-TM-X-71045; X-682-75-293) Avail: NTIS HC $3.50 CSCL 03B

The evolution of the EUV and soft X-ray emission in the event on January 19, 1972 are discussed in terms of the slow (passive) and fast (active) phases of flare evolution that were previously discussed. The implications are summarized for a flare build-up model which was derived-from these observations.

Author

**N76-17018*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**NON-ASSOCIATION OF A CELESTIAL GAMMA RAY SOURCE WITH THE NEW MILKY WAY SATELLITE GALAXY**
R. C. Lamb, D. J. Thompson, and C. E. Fichtel Dec. 1975 9 p refs Submitted for publication
(NASA-TM-X-71047; X-662-75-321) Avail: NTIS HC $3.50 CSCL 03B

The newly discovered satellite galaxy located in the Milky Way galactic anti-center region is discussed along with the possibility that a nearby gamma ray source is associated with it. The factors which led to the conclusion that the gamma ray excess is not associated with the galaxy are considered. D.M.L.

**N76-17019*#** Scientific Translation Service, Santa Barbara, Calif.
**RESEARCH ON COSMOPHYSICS AND AERONOMY**
G. F. Krymskiy, ed. Washington NASA Dec. 1975 198 p refs Transl. into ENGLISH from "Issledovaniya po Kosmofizike i Aeronmii" Yakutsk, 1975 p 1-191
(Contract NASw-2791)
(NASA-TT-F-16645) Avail: NTIS HC $7.50 CSCL 03B

Articles on experimental research of cosmic rays and physical processes in interplanetary space and the earth's magnetosphere are presented. Articles are also included on the equipment and methods used in cosmo-physical and geophysical research.

Author

**N76-17020#** Chalmers Univ. of Technology, Goteborg (Sweden).
**MASER RADIOMETER OBSERVATIONS OF WATER VAPOR EMISSION FROM HII REGIONS AND IR STARS**
B. T. Cato, B. O. Ronwang, P. T. Lewin, O. E. H. Rydbeck, and K. S. Yngvesson 1975 82 p refs Prepared in cooperation with Mass. Univ., Amherst
(PB-244891/8; RR-123) Avail: NTIS HC $5.00 CSCL 03B

The spatial structure of water vapor microwave line emission has been investigated with moderate angular resolution in the HLL regions of W28, W43, ON2, W75, and NGC 7538. Several new H20 sources have been found. Three of them are preliminarily identified with infrared (IR) sources. One of these sources, IRC-20411, has been investigated at optical wavelengths. A search for LTE water vapor line emission in molecular clouds associated with HLL regions is also reported. GRA

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No abstracts in this category.